RAILROAD GAZETTE

FRIDAY, MARCH 6.

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Contributions.

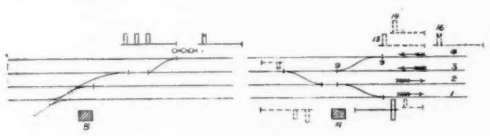
The Rahway Accident.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I have read your report and editorial on the collision at Rahway, N. J., on the 16th inst.

Although the block system in use is not perhaps the best that can be desired, it should not be made to bear blame that does not attach to it. Below I give you a more correct sketch of the track facilities at "*A*" and "*B*" than the one you showed.

It is admitted that the accident was caused through the operator at "*A*" mistaking which track the freight



train had taken. The switches at "*A*" are worked by ground levers. There are no signals for the freight track, and of course no interlocking of switches and signals. "*B*" is properly signaled and interlocked. It is easily seen that had "*A*" been so signaled and interlocked this accident would not have happened.

For reference, I have shown in dotted lines an arrangement of signals which, with an interlocking machine and coupled-up switches, would have prevented the misunderstanding in this instance. 15 and 16 are the "home" and "distant" signals for track 3. 14 is the signal for track 4, fitted with indicators to show whether a train on track 4 is signaled to go to track 3, or straight along track 4.

Assume that the freight arrived at "*B*" on track 3, and the operator thought it was on track 4, his signals would have disclosed his error. If he lowered 14, the engineman, knowing he was on track 3, would have whistled for main line signal 15.

Assume that the freight train arrived at "*B*" on track 3, and was supposed to shift on to track 4 before going forward; the switches being operated from the tower, this movement would be made by the sanction and under the guidance of the operator.

The train having taken track 4 through the switches 9 9, the engineer would not be justified in starting forward toward "*B*" without a signal. The operator, having put him on to track 4, would have given signal 14. There could then have been no mistake as to which track the train was on.

ENGINEER.

Audible Signals.

RAHWAY, N. J., March 2, 1891.

TO THE EDITOR OF THE RAILROAD GAZETTE:

By the recent Fourth avenue collision, which has been so ably and impartially commented on in your issue of Feb. 27, the attention of railroad companies and the general public is forcibly attracted. Although in this instance evidence points to the probability that reliance on audible signals was a considerable factor in the causes leading to the accident, it has not led to a feeling of distrust in them.

The time is opportune for the thorough investigation of audible signals as adjuncts to visual signals.

Are we likely to get the best results by following in the old beaten track? Inventions for operating audible signals are numerous, but I think when we take a broad and comprehensive view of this part of railroad signaling we shall discover that the efforts put forth have been to a certain extent misdirected. I refer to a feature possessed by all that I have seen, namely, the moving into and out of operative positions, from a distance, of the audible signals when they are on or alongside the track, or of those parts intended to operate audible signals when such are placed on the locomotive, the aim being to audibly indicate to engineers whether signals are at "danger" or "clear."

There appear to me to be serious objections to this principle. First, engineers are liable to be encouraged to rely on the audible and to neglect the visual. Second, the parts being operated from a distance are not reliable; they may be broken and left for some time in that state, or they may fail to act. Third, it gives no sure indication of the accidental obliteration of a signal, because it only gives a sound when a signal is at "danger," and is silent when a signal is "clear."

I think that, by aiming at less than this, we shall accomplish more, and repeat here my suggestion made some years ago.

Put it into the power of all enginemen to enlist the audible element into service whenever they need such assistance, not for the purpose of indicating whether a signal is at "danger" or "clear," but to inform themselves of the location of signals, trusting to sight as to the state of the signals. This may be accomplished by fixing on the side of the track at any desired point outside each distant signal a long inclined piece operating an audible and visual signal in the cab of the locomotive by means of a rod suspended from it. The incline, being a fixture, may be extended any desired distance, communicating a gentle movement at high speed to the suspended rod.

It appears to me that there are weighty reasons in favor of this principle. First, the parts placed on the track side, being fixed and having no machinery, are not liable to derangement. Second, the moving parts, being on the locomotive, are constantly under the observation and care of the engineer as much as the other parts of his engine. Third, it possesses this quality, namely, that the audible does not convey to an engineer the information as to what the visual signal would indicate to him, but simply says: "Here I am; look to me for a sign. You know I am, or ought to be, here, and if you can get no sign from me, owing to accidental obliteration or atmospheric or other obstruction, you must assume my sign to be danger." Under such a system engineers cannot possibly be led into trusting altogether to their ears for a signal to go ahead or stop. Fourth, it enables an engineer to obey the following rule: "The absence of a signal where a signal is ordinarily shown, or a signal imperfectly exhibited, must be considered a danger signal and treated accordingly, and the fact reported to the operator or station agent." At present he trusts to his knowledge of the exact location of every signal. However good this may be, he is liable to be deceived, particularly in foggy or other bad weather.

I have so far referred to the auxiliary or "distant" signals; home signals admit of something different. The practice in general use in France is to connect a detonator to these signals, so that when at "danger" the detonator lies on the rail, and when "clear" it is withdrawn. This is an excellent and cheap arrangement, because home signals are never supposed to be passed when at "danger," and differ from the distant signal in this respect. Here we have another simple arrangement certain to give an audible indication when a home signal is passed while at "danger," and to leave evidence of the signal having been so passed.

I have never seen or heard any objection raised to this latter arrangement, nor do I see that any sound case can be made out against it. With regard to the former, it has been looked upon as objectionable to equip locomotives with audible signals. Why this is so I have never been able to see. The difficulties are imaginary. When used in connection with a fixed object on the side of the track, as I here suggest, it is probably more economical than any other audible signal. The expense is, to a great extent, proportioned to the amount of traffic on any railroad, because the fewer the locomotives running, the fewer the equipments. The objection raised in your last issue loses its force in this case, because the engineer of any locomotive not fitted with the audible signal would be aware of the fact, and would know that he depended entirely on sight to inform him of the location of a distant signal, and he could not pass his home signal at "danger" without receiving an audible indication that he had done so.

H. JOHNSON, *Signal Engineer.*

Irregular Wear of Locomotive Tires.

LONDON, Feb. 20, 1891.

TO THE EDITOR OF THE RAILROAD GAZETTE:

One of the first things which strikes one on reading Mr. Barr's paper under the above head is the fact that flat places on the tyres do not coincide with the position of the balance weights, which would seem to indicate the possibility that the practice so common in England of using long, crescent-shaped counterbalances is hardly called for. Flat places wear, as one would expect, at points on the tyres where there is a tendency of the wheels to slip on the rails.

If the two sides of an engine were independent of one another and the balance weights consequently exactly opposite the crank pins, it might be expected that the full effect of the centrifugal action of the counterbalances, combined with position of maximum lever arm of crank, would produce flat places, either exactly opposite the weights or at some small angle previous to this position, where the load on the rail, being heavier than at the top position of the weight, and the torque of the crank perhaps more, on account of the steam pressure being higher than at the position of maximum lever arm, slipping, when occurring, would produce more abrasion.

At the same time, it may be that highly concentrated balances may have a wearing effect on the tyres, when the weights are down, due to the repeated compressions to which the tyres are subjected.

According to Mr. Barr's diagrams, the back wheels, which are subject only to centrifugal action, and are comparatively little influenced by the guide bar pressures, show flat places opposite to the counterbalance in the wheel at the other end of the axle, or nearly so, and this points to the correctness of Mr. Barr's contention that the wear is much influenced by weight, for here we get the lifting action taking place in the wheel on one side of the engine and going to cause slip by reducing the adhesion below the rotative force, and the abrasion taking place upon the tyre at the other side of the engine where the weight is sufficient to cause abrasion, but still insufficient to prevent slip.

Further, it is noticeable that at about 200 degrees, when the back right wheel shows slip and wear, the front right wheel, which must, of course, slip, shows no wear, though it has the apparent necessary abrading load. Inspection shows us that the crank is then getting past the back dead point, and the full steam pressure is lifting the front end of the engine. But is it not also helping to press down the wheel on the rail? This, then, would not account for the non-wear of the right front tyre at the 200 degree position. We are told, however, that the two wheels share equally in the counterbalance, and yet we know that the main rod can only affect the front wheel. It would appear, then, that the influence of the main rod is sufficient to reduce the load on the wheel to the point of non-abrasion.

We note again that both front wheels and only one back wheel wear at and about the position of 100 degrees. Is this also explicable? It is the right front wheel again which differs from the right back wheel. Here again the main rod would seem to afford a reason for wear, for which the back right wheel has less than 11,000 lbs. load from 40 degrees to 140 degrees, the front right wheel has over 11,000, in fact nearly 12,000.

Assuming that investigation of other engines shows a general similarity of behavior, it will be clear that the wear of tyres is a somewhat complicated matter, and that the cause of wear must be sought elsewhere than in the wheel within the worn tyre, being a complicated compromise between the cylinder pressures and the counterbalances, and occurring at critical points in the revolution; that tyre wearing which has load enough on it to prevent it slipping if independent, and that tyre being saved which by its light loading is the cause of the slip which wears the heavily loaded tyre.

In the foregoing I have assumed that the main rod is unbalanced.

I should like to ask Mr. Barr whether the diagrams show the actual relative positions of crank pins and balances, or whether they should not be shown not exactly opposite their respective cranks.

For inside connected engines the counter weights require to be considerably removed from the crank diametral line, and, though to a less extent, the same applies to outside cylinder engines; and, in view of the importance attached to the lightest possible balance weights, would it not be a better practice to place these in their best position, viz., a few degrees before and behind their respective cranks, according to the relative influence of the reciprocating parts on the two sides of the engine to each wheel, which is proportionate to the distances from the two cylinder centre lines to the plane of revolution of the respective wheels?

Mr. Barr does not seem to have taken any account of inertia in figuring on the rotative effort on the crank. This would tend to increase the ratio of rotative force to adhesion from about 130 degrees to 220 degrees, and again from about 300 degrees to 30 degrees. I should not think it likely that the wear of tyres due to slip takes place much when running: the ordinary slipping at starting will probably account for the chief portion of the wear. At high speeds especially the tendency to slip is reduced below what ordinary methods of figuring would show probable by a factor of neglected account, namely, the large amount of inertia in the wheels as compared with the duration of steam impulse which at high rates of revolution must offer greater resistance to any sudden force tending to cause acceleration than is offered at lower speeds when the piston impulses are of greater duration.

Mr. Barr is to be thanked for the manner in which he has presented this subject, which makes it very interesting.

W. H. BOOTH.

Details of Class "B" Locomotive, Chicago, Milwaukee & St. Paul.

In the *Railroad Gazette* of Feb. 20 were given elevation and sections of the class "B," 16 × 24-in., express locomotive of the St. Paul, with the specifications. We now give some of the principal details:

The boiler, fig. 1, has some features of construction

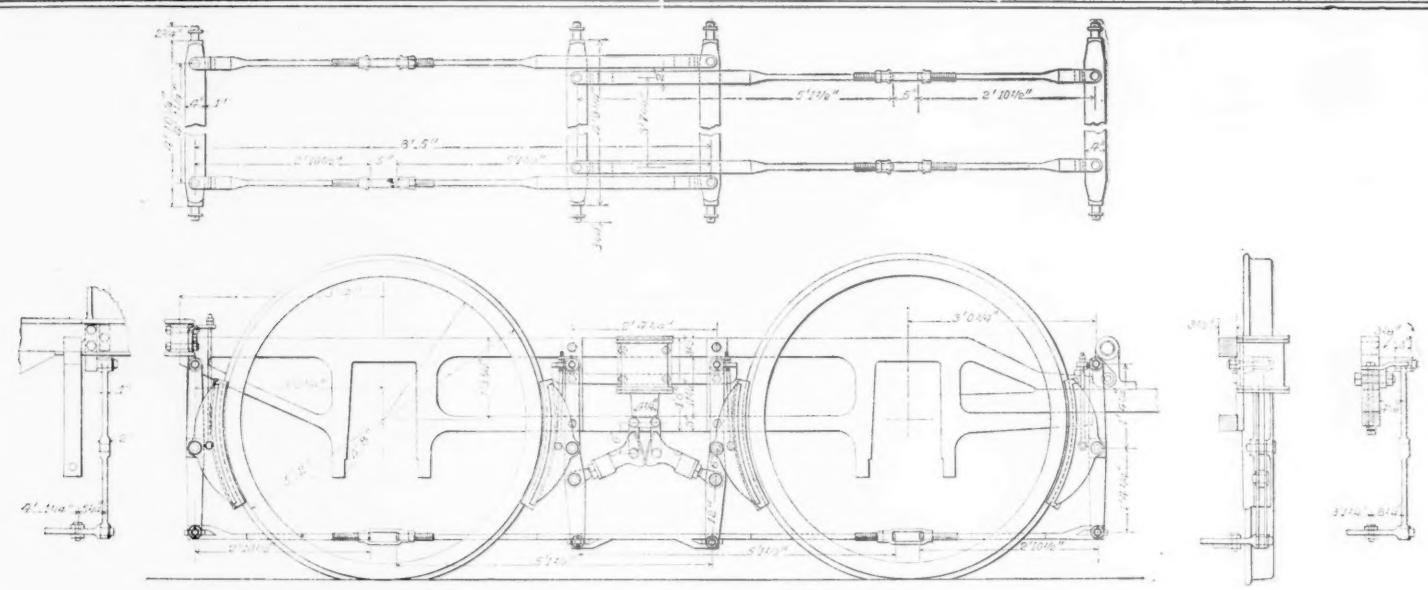


Fig. 9—Driver Brake Gear.

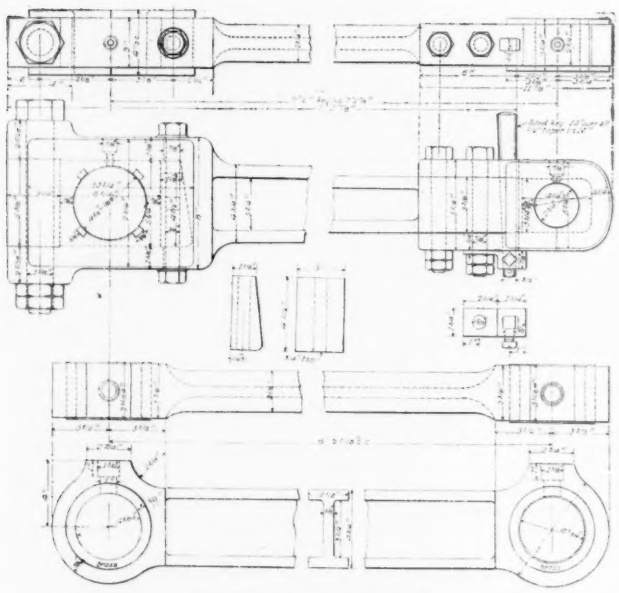


Fig. 6—Main and Side Rods.

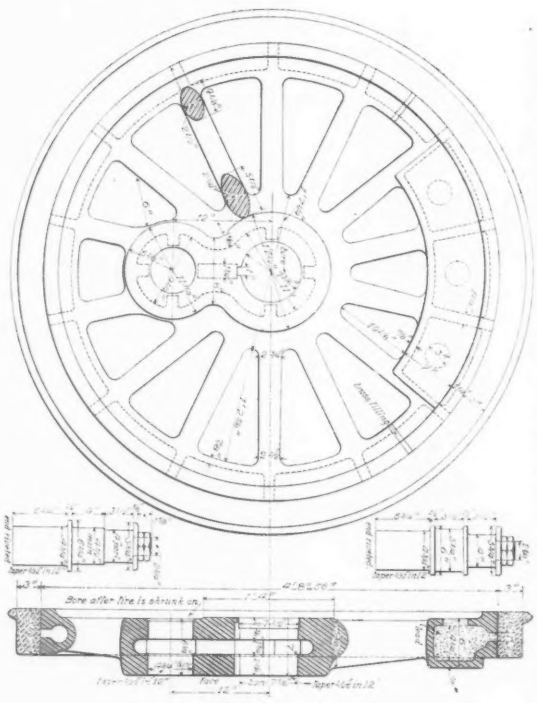


Fig. 8—Driving Wheel.

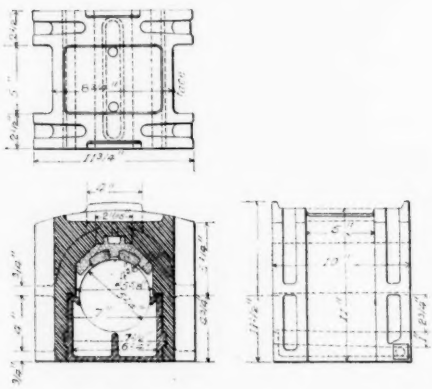


Fig. 7—Engine Truck Box.

DETAILS OF CLASS "B" EXPRESS LOCOMOTIVE.

which deserve attention. It is designed to carry 160 lbs. steam pressure, and is made of ½-in. plates. All roundabout seams are double riveted, and all longitudinal seams are double riveted, with a welt, as shown in the details of the joints, fig. 2. Each seam has two of these welts, dividing the seam into three parts. Welts are also placed, as shown in the side elevation, fig. 1, on the roundabout seams at the bottom of the boiler.

Probably the most interesting feature of this design is the radial-stay, wagon top which has been introduced so largely by the Baldwin Locomotive Works within the last few years. It is formed by extending the wagon top ahead one course beyond the back tube sheet, and on this extension the dome is placed. The advantage in point of steam economy must be considerable, as the steam space is largely increased, and the point from which the steam is taken for the cylinders is raised considerably above the water line.

We have illustrated several boilers of this type, but in no case have the stays been shown so fully as in this particular one. The freedom of the water and steam space from a confusion of stays in this design as compared with the crown, bar wagon top, or even the Belpaire, is seen from the illustration. It will be noticed that there are only vertical stays and no pockets or crevices in which scale and mud are liable to lodge and cake. A crown of this sort keeps itself very clean, and is readily washed or scraped.

There is another advantage claimed by the Baldwin Locomotive Works for this design, which is appreciated by some who have used it. It is the safety which it offers when, from careless handling, a crown sheet gets hot. With a flat crown the whole top goes down together, resulting in disastrous explosions, whereas in this design several instances of hot crown sheets have shown that only a few centre bolts pulled out, which relieves the steam pressure immediately and puts out the fire, and the crown sheet cools down. It is even argued that nuts should not be put on the under side of the middle stays, as shown in this design, because of the greater ease with which a riveted stay will pull through a sheet than will a stay with a nut on it. We have known cases where one-half of the stays have had nuts and one-half have been without. A serious explosion was avoided by the pulling out of the screw stays, the stays with nuts remaining intact. However, this is a matter of opinion largely; but the adherents of the Belpaire type who object to the radial stay boiler, because nuts in some cases cannot be used under the crown sheet, have no ground for objection in this type, because, as shown in fig. 1, the six centre rows have nuts on the under side, as is customary with the Belpaire boiler.

The method of staying the back head in the design is a favorite one with some stationary boiler builders, and certainly is more reliable and less conducive to cracks than where angle irons are used with a smaller number of stays. However, the types of back head staying are numerous, and good arguments for each are offered by their adherents.

Those who have had trouble with the pipes which support the firebrick arches should examine those here shown, as they are the result of considerable experiment on the St. Paul road. The pipe is a 3-in., extra thick, lap-welded tube, and is expanded into the front tube sheet and the top sheet of the firebox by means of the ordinary expander, which is passed through the openings in the back head and in the throat sheet; these openings being closed by means of a 2¾-in. brass plug. With this arrangement all threads on the firebrick support are avoided; it is not screwed into either sheet, and does not give trouble by cracking off. Again, owing to the curves formed, expansion is allowed for, and the tubes can be readily cleaned by a wire scraper, which is not the case when the end of the tube passes up through the crown sheet. The ordinary pipe is made 2 in. in diameter and often gives trouble from plugging up and burning out; with this 3-in. pipe all trouble with supporting pipes has been removed on the St. Paul road.

Fig. 3 shows the throttle rod pipe and the arrangement of the end connections. This is a good arrangement, and gives a place for boiler mountings without cutting holes through the top of the boiler in the cab. Provision is made for dry steam by means of the elbow screwed on the inner end of the 3-in. pipe, from which passes vertically another 3-in. pipe to the top of the dome. The drawings show clearly the details of construction.

The steam chest, fig. 4, has some points in design which are not possessed by the ordinary chest. It will be noticed that there is an annular rib passing entirely around the chest at the centre line, and where the bolts are located there is an enlarged boss which maintains approximately an equal strength in the rib at points. Such a chest has a greater strength for the same thickness than the ordinary form without ribs, and it has the advantage also of a mechanical appearance not possessed by a plain cast iron box.

Fig. 5 shows the arrangement of the steam and exhaust passage in the cylinders. Of course, it is easy to get satisfactory steam passages in a small cylinder; but easy as it may be, it is not always done. Undoubtedly the satisfactory operation of these engines is largely dependent upon the ports and steam passages which are large in proportion to the cylinder. The length of the steam ports is the same as the diameter of the cylinder, and being 1¼ in. wide, they furnish little obstruction to the passage of the exhaust, and, with a good valve motion, there is a considerable port opening, even for short cut-offs.

We have not at hand the weights of the parallel and main rods illustrated by fig. 6, but they are as light as any that have ever been used on a 16-inch engine, so far as we know. The main rod shown was substituted for a rectangular section used on previous designs, which weighed nearly twice as much as the one shown. There has been in the last few years a decided improvement in this country in locomotive rods, and those for this engine may be considered as among the lightest and strongest of them all. The thickness of the web of the main rod is three-quarters of an inch, and the thickness of the flange of the I section, top and bottom, at both ends of the body of the rod, is three-quarters of an inch.

The engine truck box, shown in fig. 7, has some features of construction which have proved very successful on the St. Paul road. The lining is a segment of an octagon in section, and is held in position longitudinally

BOILER AND ENGINE DETAILS OF CLASS "B" EXPRESS LOCOMOTIVE—CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

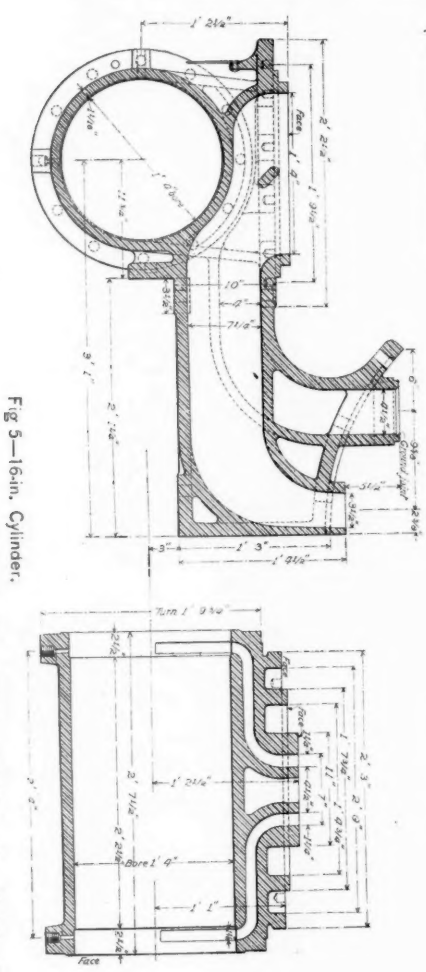


Fig. 5—16-in. Cylinder.

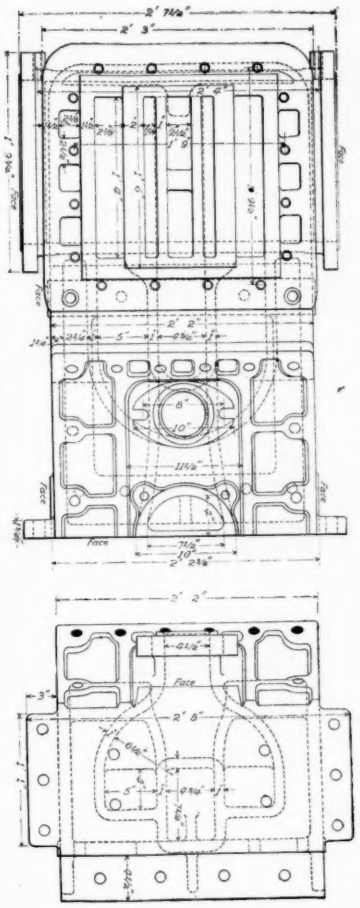


Fig. 3—Throttle Rod Pipe.

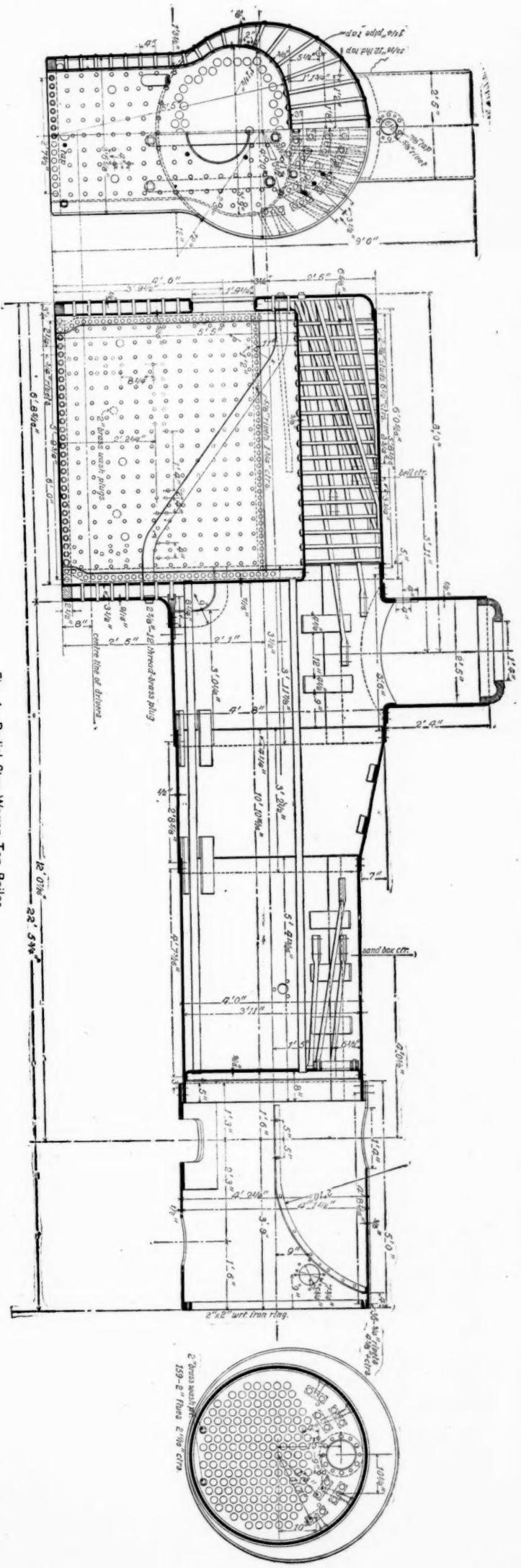


Fig. 1—Radial Stay Wagon Top Boiler.

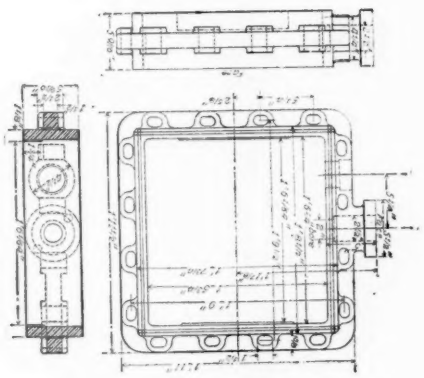


Fig. 4—Steam Chest.

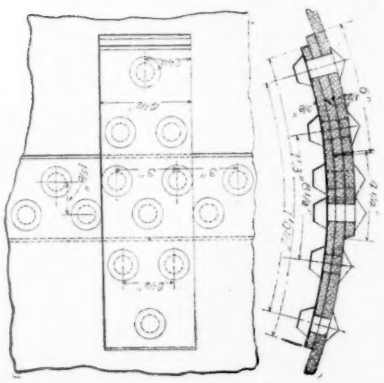


Fig. 2—Boiler Laps.

by means of a boss, shown in the centre. The journal does not bear against the brass at starting or for some time thereafter, but rests upon two strips of babbitt which project beyond the brass, as shown in the section. A hot truck-journal box is almost never had with this construction, which is a standard for all St. Paul engines. To prevent oil from the cellar passing around the journal and dropping down between the cellar and the box, and passing out over the wheels and being wasted, the inclined lips shown are used, which conduct the oil back into the cellar as it drops from the brass or is thrown off from the journal.

All know the attention which Mr. J. N. Barr, Superintendent of Motive Power of the St. Paul, has paid to the foundry department, and the results which he has obtained in casting all manner of wheels; therefore the illustration of the method which he follows in coring out the driving-wheel hubs and counterbalances will be of interest. It will be noticed that the crank-pin hub core and the centre hub core are joined together, as shown in fig. 8, and that the counterbalances are cored out and filled with lead from the back side. This system of coring gives a strong wheel and removes the losses which are sometimes met by cracks in the spokes where they join the counterbalances. The location of the rim cores and the dimensions are too clearly shown to need further description. The crank pins and driving axles are forced into the wheels with the taper shown on the drawing, the axle being recessed in the wheel on the inside in order to prevent starting points for cracks, which are common to those axles that have a shoulder where the wheel hub ends.

The squeeze brake for the driving wheels, shown in fig. 9, has some admirable features. It is very simple in form and readily adjusted at all points. The drawings show clearly how the brakes are hung, the lengths of the levers, and the method of attaching the tension rods to the brake beams.

As we have before stated, these engines have a very large steam space, and the throttle is so located as to reduce to almost the lowest possible point the amount of water that may be carried over in the cylinders. Also, the type of the boiler is such that it will collect less scale and sediment on the crown sheet than the boilers formerly used on the engines on the St. Paul road. Hence it may be expected that the present saving found with these engines over former designs will be carried out in the future, and that the economy will be greater in proportion, the longer the engine is in service, because of the reduction of the scale and mud deposit. We stated in the description accompanying the illustration of this engine in the *Railroad Gazette* of Feb. 20 that the first engine built had run 70,000 miles up to date, with a cost for repairs of 91 cents per 100 miles, and the firebox had not received any repairs since the engine went into service, which speaks very well for the radial stay wagon top.

Car Lighting.*

The various methods employed for railroad car lighting from early days until the present time have followed the process of evolution observed in other departments of railroad work, beginning with the simplest and following in the direction of the more complex. A multiplication of detail and an amount of attention to operation which would have been considered quite inadmissible a few years ago is expected now as the inevitable result of progress. I may, therefore, in this necessarily incomplete review of the subject, properly call attention to a number of schemes recently advanced for the solution of the lighting problem, which, although involving considerable expense and skilled attention, appear to offer collateral advantages.

Car-lighting methods can be classified under the following general heads, and will be considered in their order: 1st, candles; 2d, vegetable oils; 3d, mineral or petroleum oils; 4th, ordinary coal gas; 5th, carbureted coal gas; 6th, "rich" or oil gas; 7th, carbureted air; 8th, electric.

1. GENERAL DESCRIPTION OF METHODS.

[We omit Mr. Gibbs' brief review of the first five methods simply to save space.—*Editor.*]

Sixth Method, "Rich" or Oil Gas.—The lighting of railroad cars by means of compressed gas obtained from distillation of petroleum has been in use abroad for many years, notably on the Belgian and German State railways. In 1887 official statistics give for Germany 11,938 cars lighted by gas (Pintsch system) out of a total of 19,663 cars, while to-day, I am informed by the company introducing the method in this country, their European installations foot up to the large total of 36,000 cars equipped. In America this system of lighting, as represented by the "Pintsch," is making rapid headway, nearly 2,000 cars being fitted with it to date. Its principle can best be described by referring to the Pintsch system.

This is by far the most prominent attempt to devise an economical and practical gas-lighting system I have examined. Its primary object was to reduce the bulk of stored gas necessary to produce an adequate illumination for a considerable length of time. The directions in which improvement in this respect was to be looked for were obviously in the quality of the gas, the method of burning it, or both.

The Pintsch system has largely confined its attention to more efficient gas, which, it is claimed, is supplied by the use of a rich permanent "oil" gas. Ordinary city or coal gas when burnt at pressure of the street mains, one to one and one-half ounces, may be taken to give an illumination of, at the most, four candles per cubic foot. Oil gas at the same pressure will, it is claimed, give from four to six times as much, say, 16 candles per cubic foot. But one property of gas which vitally affects the problem is the loss of light-giving power upon compression and storage. This is true of all gas, and is due to the deposition of the rich oily hydro-carbons, but is not true to the same extent for oil and coal gas, the difference being materially in favor of oil gas. Reliable tests for this loss of light by compression have given the result that coal gas loses 50 per cent. and oil gas 21 per cent. of light-giving power upon compression of 300 lbs. per sq. in., and at 225 lbs. per sq. in. pressure the quantities required for equal illumination would be about as 5 of coal to 1 of oil gas. . . .

It is obvious that the general adoption of a gas-lighting system would entail the erection of suitable generating works or other means of supply at such points that the entire equipment would be reached regularly for recharging with gas. In considering this problem for the St. Paul road it appeared that its passenger service included 570 cars in active service, out of shops; that practically the entire main line traffic and some on branches could be reached from seven distributing points, and that all of this traffic east of the Mississippi River and some west is reached from three centres, handling 376 cars out of the 466 included in the seven centres above.

The cost of erecting gas works of varying capacities is as follows:

	Apparatus.	Building.	Total.
To supply 500 cars.....	$11,000	$4,500	$15,500
" " 200 "	9,500	4,100	13,600
" " 100 "	7,500	3,000	10,500

Therefore, suitable works at the seven distributing centres above mentioned, allowing 500 cars capacity plant at one place, 200 cars plant at two places and 100 at other points, would cost $84,700, or, for the three main centres, $42,700. Taking the first estimate, each car's proportion of the expense of works would be, on a basis of 466 cars handled, $181.75. Figuring on the second, the number of cars handled would be 376, or a charge to each car for stationary equipment of $114.

Seventh Method, Carbureted Air.—The only instances I can find of the use of carbureted air gas abroad were trials made in England some time ago of the so-called "Westinghouse" system on the London & Brighton and South Western railways. The system was abandoned, however, on account, as stated, of the danger attending the use of volatile oils and the difficulty of regulating the quality of the gas. In this country the only attempt to attack the problem in a scientific manner is by the Frost system.

In the Frost and all similar systems the principle is the same, being the property possessed by air of holding a vapor in intimate mixture and suspension, usually the vapor of gasoline. The amount of vapor absorbed depends upon its temperature; Thus, at 14 degrees above zero, about 6 per cent., and at 68 degrees, 27 per cent. will be taken up. This is, however, a mechanical mixture only and not a permanent gas. The vapor thus formed is capable of being burned similarly with gas, when mixed with air in the proper proportions, giving a highly luminous flame. . . .

The difficulties to be overcome in using this agent for safe car lighting are as follows: First, the presence of liquid gasoline. The Frost system overcomes this objection by filling the carbureting vessel almost completely with wicking and, by merely saturating this with the gasoline, draining off the superfluous liquid. Second, the effect of variation of temperature in the amount of vapor absorbed by the air current. As above stated, in cold weather only a small percentage is absorbed, too little to produce a good light; and in warm weather too much, producing a rich but smoky light. This is really the serious stumbling block to all schemes of this kind. The Frost system claims to entirely overcome it by placing a small generator or carburetor above the light on the roof of the car, in such a manner that a portion of the heat generated by the burner is transmitted to the carburetor, insuring a uniform temperature at all times.

The system in detail* consists of an air storage tank underneath the car, containing sufficient compressed air to supply light for six hours. This compressed air is obtained directly from the train pipe of the air brake and is lead through a suitable pressure reducer and a regulator to the carburetors in the roof, one of these being placed over each lamp, and thence, after passing through them, to the lamps underneath. These are now constructed on the "Siemens" or "regenerative" principle and give a brilliant white light without shadow. The supply of gasoline in the carburetors is sufficient for 43 hours burning, and then can be recharged by filling from the roof.

Eighth, Electric Method of Lighting.—The latest phase of train lighting may be said to be the electric. In this direction numerous isolated experiments have been made in this country during the past five years, but the subject, as usual, has attracted greater attention abroad than here. The different plans suggested for obtaining electric light are divided as follows:

1. Primary batteries.
2. Secondary batteries or accumulators.
3. Dynamo machine connected to car axle, with or without accumulators as auxiliaries.
4. Dynamo operated by special steam engine, either in a car or on the locomotive, and supplied with steam from locomotive or special boiler on a car; accumulators either used or not, as desired, as equalizers.
5. Electric current supplied to the train by contact with wires along the track.

The first method has been tried in England on several railways, and in France on through trains between Paris and Brussels. No trials have been made of it in this country, as far as I am aware. In all, a special form of primary battery, having very low resistance, great surface, and furnishing a constant current at high pressure, was employed. The result was, and always will be with present known forms of primary batteries, flat failures, on account of the enormous expense of the electrical energy furnished by chemical means. The minor disadvantages connected with secondary batteries, mentioned later, are also present. A good idea of what is being attempted will be had when it is said that in primary batteries chemicals are expended and zinc or other metal burnt, instead of coal under a boiler, to produce energy; at the lowest estimate, the former is forty times as expensive as the latter method.

Second method—In England, the London & Brighton Railway made an extensive trial on a Pullman train of lighting by accumulators alone, placing batteries under each car, and having a sufficient number of charging stations, with boilers, engines and dynamos, to charge duplicate sets of batteries for immediate replacement. This system, after five years' trial, was abandoned for the one to be described later. In this country the Pullman Co. gave the method a thorough trial on the P. R. R. "limited" between New York and Chicago, finally abandoning it for a later one. It was also tried and abandoned on the B. & A., the C., B. & Q., and possibly in other instances. I understand it is in use on the Canadian Pacific, to a limited extent on the Burlington, Cedar Rapids & Northern, and on some parlor cars on the Pennsylvania.

Description of this system may be dismissed briefly by saying that each car carries its own store of batteries in boxes hung underneath, arranged so that they can be readily removed at terminals for recharging by dynamo, or for substitution of fresh cells. The weight of batteries required for a standard coach is, approximately, one ton.

Third method—A favorite scheme for obtaining electricity at a low cost seems to have been to connect the dynamo to a car axle; but the difficulties of obtaining regular motion and current, and providing light when the train stops, have necessitated the employment of accumulators as regulators and auxiliaries. In these plans automatic appliances are provided to cut off the current from the dynamo when the speed of the train falls below a certain rate, and to deliver the current to the batteries in the same direction, no matter which way the train may move. Many foreign railroads have tried this plan, the most successful instance being of the "Pullman Limited" on the London, Brighton & South Coast, where the system is still in use. The main difficulty, and one which the International Railway Congress state has not been solved satisfactorily, is the method of transmission of power from the axle of the dynamo. This should offer less difficulty in the case of foreign cars, with their rigid wheel base, than with our bogie construction of truck, and, although not a mechanical impossibility, other methods seem to offer a better solution.

The fourth method is the only prominent one in this country, but does not seem to have been a favorite abroad; the "Timmis system," in use on the Midland Railway (England), is the only instance I can find mentioned. Here, the Connecticut River road was probably the first to introduce it, being followed by the Pullman Co., on the P. R. R., A., T. & S. F., C., M. & St. P., Union Pacific and on other isolated trains. The general idea in all is the same and consists in the use of a dynamo driven by a special steam engine, with secondary batteries for reserve. The use of the method without the batteries as auxiliaries has been attempted without much success by the Metropolitan (London underground) Railway, in 1884, and in Germany. Difficulty was experienced in obtaining a light and compact steam engine.

The fifth method is used in a number of places in England and Russia for lighting trains for the time being, when passing through tunnels. Small contact wheels on the car run on a third rail or wire conductor along the track, completing the electric circuit through the lamps when needed. The method is obviously only adapted to special uses.

As illustrating the development of the electrical method of train lighting on without doubt the largest scale in the world, a brief description of the experience of the St. Paul road will probably suffice.* The system first experimented with some two years ago, and used for a year on two trains, consisted in having a small engine coupled direct to a dynamo of 100 lights capacity, the plant being in the forward end of the baggage car. Steam for the engine was obtained through the train heating pipes from the locomotive at 60 lbs. pressure. The electrical mains were run on the roofs of the cars under tin, and branch wires brought into the cars for the lights. Under each car were carried 32 cells of secondary batteries, weighing from 1,500 to 2,000 lbs. The electrical arrangements in the baggage car were of a novel character, and allowed the use of the lights direct from the dynamo, from the batteries, or from both simultaneously. They also permitted charging the batteries while running the lights, without affecting the latter, a highly important feature and a distinct advance upon the old methods of storage battery lighting.

In spite of the quite perfect character of this outfit and great care given its operation, we were quite ready to abandon it. Briefly, its very serious defects were heavy first cost, rapid depreciation of batteries (which I estimated at about 40 per cent. per annum), the multiplicity of detail requiring skilled attention, the poor economy of the special engine and the wasteful character of the whole arrangement in current.

After about one year's experience with the above the following improvements suggested themselves, and constitute the system in use at present: It was considered feasible to do away with storage batteries entirely, relying upon direct generation of the electric current by a dynamo run by special steam engine. The plant, in fact, was made an exact duplicate of stationary electric lighting plants, which experience has demonstrated can be depended upon for continuous work for long periods of time without failure of any kind. In order to insure reliability without further experimenting with special devices, a standard type of engine and dynamo, to be had on the market, was adopted. The engine is a 15 horse power Westinghouse automatic, the dynamo a 150-light Edison, compound wound, connection from one to the other being made by belting. In the summer season, when steam heat is not required for the train, this outfit is placed in the forward end of the baggage car, occupying 12 ft. in the length of the car, but not obstructing passage way through it. Steam is taken direct from the locomotive boiler at 60 lbs. pressure.

In winter, the drain upon the locomotive for steam heat and the light proved a very serious matter on our heavy trains, and at times the steam supplied was totally inadequate for proper heating, to say nothing of lighting. It was therefore determined to use a special car for the heating and lighting during this season. Space will not permit me here to go fully into the experiments instituted to prove the economy of this departure. Suffice it to say that we proved that at least 12 per cent. of the steaming capacity of the locomotive was required for heating and lighting a train of 10 cars, in weather above zero degrees, while to haul the extra car we estimated not more than 6 per cent. additional was required. Furthermore, the drain upon the locomotive for lighting and heating is a dead loss of so much steam, adding nothing to the capacity of the furnace to burn more fuel, while the extra power developed in the engine cylinders produced further means for urging the fire.

Quite a complete description of this special car, or "Light and Heat Tender," as we call it, will be found in the *Railroad Gazette* of June 13, 1890. It contains a locomotive type of boiler of special design, coal bunkers with sufficient fuel capacity for 500 miles run, tank containing three hours' water supply, engine, dynamo and the various fittings necessary for regulating the supply of heat and light to the train. The whole is under the charge of one attendant, who fires the boiler, runs the engine for furnishing the light, has charge of the heat supply

* Abstract of a paper by Mr. George Gibbs, Mechanical Engineer Chicago, Milwaukee & St. Paul Railway, read before the Western Railway Club at the February meeting.

* See *Railroad Gazette* of June 7, 1889, and July 18, 1890, for descriptions, illustrated, of the Frost system.—EDITOR.

*For a full description, with illustrations, see *Railroad Gazette*, June 13, 1890.—EDITOR.

and the regulators for controlling the same, in fact, is wholly responsible for maintaining both these functions in first-class condition.

The electrical equipment in active service on the St. Paul road comprises the following:

Class of Car.	*No. in Service.*	*No. Lamps Per Car.*	*Total Lamps.*
Baggage	8	6	48
Mail	5	10	50
Mail and express	4	9	36
First-class coach	15	12	180
Chair	3	13	39
Parlor	5	18	90
Dining	5	19	95
Sleeping	17	34	578
Light and heat tenders	2	6	12
Total	64		1,128

Four through trains are lighted each night, two between Chicago and St. Paul and Minneapolis, and two between Chicago and Council Bluffs and Omaha. On account of the much heavier service on the Chicago-Minneapolis run, the tender cars are used there only, the Council Bluffs run having light supplied from the baggage car outfit.

II.—AS TO THE AMOUNT OF LIGHT REQUIRED.

Opinions will doubtless differ upon this important head. I offer the following as requisites for satisfactory car lighting:

1st Requisite.—The headlinings in cars should be light in color and warm in tone; the surface should not be of such a high polish as to reflect light locally in a manner unpleasant to the eyes. The numberless mirrors often added for decorative effect are generally a nuisance, making impossible the

2d Requisite, which is to set the lamps in such a position that passengers may readily screen their eyes from direct view of the flames of light. This condition demands that lamps be placed high.

3d Requisite.—Good general illumination demands rather a large number of comparatively feeble centres of light than intense concentration in a few lamps.

4th Requisite.—Economy of light demands sufficient general illumination and brilliant local lighting in positions near where the light is to be used for continuous application, as in reading. This condition is difficult to fulfill practically without infringing the second, except in the lighting or non-combustion lighting system. An attempt, and we think a successful one, to supply this requisite may be found in the sleeping cars of the St. Paul road, where additional lights have been placed in the berths in such a manner that, while they are in a position close to the object to be illuminated, they are also perfectly under the control of the passenger, the rays of light being shielded from his direct vision and that of his neighbors. . . .

The best modern practice (to which, however, I cannot agree) seems to establish the following: For 50-ft. passenger cars—satisfactory illumination, 150 candles of light in the body; for brilliant illumination, 200 candles. For sleeping cars, in the 40 ft. of main body, satisfactory illumination, 200 candles; brilliant, 240 candles. All the foregoing in overhead sources of light. To fulfill the third requisite I recommend that in electric systems the light be uniformly distributed from equally spaced focii, each having a maximum intensity of 16 candles, and that in other systems no single focus shall have a greater intensity than 30 candles; that, in case of oil lamps, where convenience and first cost so demand, these focii be equally spaced in groups of two; that in other combustion systems each focus be single and equally spaced.

III.—QUESTION OF SAFETY.

This is a highly important one, and can hardly be disposed of in the few words I am able to give it. . . .

The first system which is of consequence for discussion is oil lighting. The popular opinion, fostered by ill-informed persons and others, is that "the deadly oil-lamp must go" with the "deadly coal stove." I believe the dangerous character of this method of car lighting to be wholly a delusion. As before explained, in past years low-fire-test oil was commonly employed for car lamps, but to-day the oil is of a very different character. The old oil was undoubtedly highly dangerous, it being impossible from improper attention to have it at the temperature of vaporization in the lamp pot; thus a jar, current of air, or defect in the lamp would cause communication of the flame with the accumulated vapor, and explosion would ensue. But the nature of the oil used for car lighting to-day is not popularly understood, many imagining it to be the household quality of kerosene; it is, in fact, totally different, being a heavy oil of difficult inflammability. It may be heated beyond the temperature of boiling water without giving off vapor, and will consequently not ignite in bulk below this point. The flame in the lamp is very sensitive to draft or jar; in fact, it seems impossible for a fire to originate in case of collision from the light, as tearing a lamp from its fastenings would without fail, I believe, extinguish it. Two other sources of danger exist: First the possibility of flame coming into contact with woodwork or drapery while the lamp is in position; this defect exists in all systems of flame lighting, but would not seem to offer a valid reason for condemning such systems. The other defect, which is peculiar to oil lighting, is that spilling oil on the woodwork or cushions of a car will add to their inflammability, and in presence of *other* fire, fuel to the flames; but this fire has properly no place in a car, and, from present prospects, need not longer be counted as a source of danger.

As for the other systems of flame lighting, represented by the gas and carburetted air, the most we can say is that the elements of danger have been reduced to a minimum by careful attention to details. In the Pintsch system, explosion of a gas cylinder by overpressure or defective material is a possibility, and in such case would probably result in damage to the car sufficient to cause injury to those in the vicinity. But such contingencies, in face of the vastly greater dangers attending the pursuit of the ordinary routine of existence, need not cause much uneasiness. Spontaneous explosion of gases is an impossibility, without the mixture of the proper quantity of air and subsequent ignition in a confined space. In case of wreck the tanks of gas would, if disturbed at all, be swept from their fastenings and the contents harmlessly escape. As to the gasoline or "Frost" system, the same remarks would apply in speaking of the explosive character of the lighting fluid. The chief danger of this latter system is, however, in handling the gasoline; this substance is extremely inflammable at ordinary temperature, it being difficult to prevent its escape from packages in which it is stored. A prominent road using the system states that 18 per cent. of the gasoline evaporates from close wooden packages when standing two months in the oilhouse. Under these circumstances its general use at many points on a large system, by neccessarily ignorant men, cannot but be looked upon as a grave source of danger to life and property, and one which would require modification of the stringent oil inspection laws of many states before becoming legal.

As for the electric system, the danger of fire to the car, although remote, is not an impossibility; imperfect wiring, accidental cross contacts or meddling interference may cause intense local heating and fire to woodwork. Such contingency is made, however, very remote by the system of safety fuses adopted in the wiring, and, even if fire were started as above, its spread will be slow, allowing for passengers to escape.

IV.—COST OF THE VARIOUS SYSTEMS OF LIGHTING.

Probably the most interesting question to the railroad manager, after the advantages of a certain system of lighting have been set forth, is that of its cost. I have collected these figures from the best attainable sources, and present some interesting conclusions in the table:

COMPARATIVE COST OF CAR-LIGHTING SYSTEMS.

Figures based on service for one 50-ft. passenger coach.

System.	No. of burners. Main body.	No. of burners. Closet	Candle power of light. Per burner in body.	Candle power of light. Total in body.	Candle power of light. Entire body.	First cost of equipment.	Depreciation and 5% interest on first cost.	Cost per car per hour. Oil, cents.	Cost per car per hour. Supplies and attendants, cents.	Cost per car per hour. Total running, cents.	Cost per candle power per hour, cents.	Hours burning without refilling.	Cost of equipment per candle power.	Price of oil or fuel.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
No. 1: Candles	4	1	1	4	5	$40.00	$1.00	.82	....	....	.164	....	$8.00	9½c. per lb
No. 2: Colza oil	12	1	12	144	156	167.00	16.70	12.22	1.06	13.28	.085	14	1.07	65c. per gal.
No. 3: Mineral oil (Mochring burners)	12	1	12	144	156	167.00	16.70	1.67	1.06	2.73	.018	15	1.07	9½c. per gal
No. 3: Mineral oil (Duplex burners)	12	1	10.5	126	136½	167.00	16.70	1.21	1.06	2.27	.017	18	1.22	9½c. per gal
No. 3: Mineral oil (Acme burners)	6	1 Moch.	26	156	168	113.00	11.30	1.94	.57	2.51	.015	13	67	9½c. per gal
No. 6: Oil gas (Pintsch)	16	1	10	160	170	552.00	61.07	2.05	.55	2.60	.015	34	3.24	$1.87 per 1,00. cu. ft.
No. 7: Carbureted air (Frost)	4	1	42	168	180	536.00	80.40	3.48	1.12	4.60	.026	43	2.98	15c. per gal
No. 8: Electric. Storage and direct current	9	1	16	144	160	863.00	137.47	....	....	13.20	.083	trip.	5.40	
No. 9: Electric. C., M. & St. P. Ry. "direct"	9	1	16	144	160	395.40	36.35	....	....	9.83	.061	"	2.47	

The manner in which this table has been prepared will require some explanation. The figures are not all expected to be absolutely accurate, but I have endeavored to make them perfectly fair and as exact as my data would permit. For an equal basis for comparison, a standard 50-ft. passenger coach was taken. If special cars had been considered, it is possible the figure would have been relatively changed in some instances, on account of the unequal economy of equipment and operation of the various systems on different candle power bases.

To fulfill the conditions of satisfactory illumination, set forth elsewhere, I have endeavored to fix the candle power in the body of a car as near 150 as possible.

Column 6 provides for rather plain but sightly lamps. In column 7 the interest on first cost has been taken uniformly at five per cent. per annum; the rate of depreciation varies according to circumstances, as seen below. This depreciation is outside of the minor supplies and repairs allowed in column 9, and applies for renewal of the entire outfit at the end of a period when repairs are no longer economical. Total running cost, given in column 10, does not include charges of column 7 but is obtained by adding Nos. 8 and 9.

Column 13 gives means for comparing each system on the basis of equal candle power, and is obtained by dividing column 10 by No. 5.

Considering the systems in detail, the figures for candle light in Nos. 8 and 11 were taken from actual experiment in the St. Paul road laboratory. These for the Colza oil system were obtained in the same way. The mineral oil methods, given in lines three, four and five, are results of experiments made by ourselves on different styles of lamps and burners. The candle powers were taken at a practicable height of flame in actual service.

Figures for the Pintsch system are obtained partly from the Safety Car Heating & Lighting Co., of New York and partly from experience of a prominent road using the system for the greater part of its equipment. Column 6 includes each car's proportion of the cost of gas works, figuring on works at seven centres, as explained in the body of this paper; this amount was $181.75 per car and would vary considerably according to the individual conditions of a road adopting the sytem. The car equipment includes two gas tanks; if one only were used, $85 may be deducted. In column 7, depreciation in gas works is taken at 10 per cent. and 5 per cent. on car equipment.

For the Frost system, columns 1, 2 and 6, were obtained from the company introducing it. The others are the results of recent careful experimenting with the system by a railroad company who kindly put them at my disposal.

Column 7 is figured on 10 per cent. depreciation, which is my personal estimate, but probably does not overstate the practical figure, when we consider the fragile character of the carburetters and their exposed position. Column 8 includes 15 per cent. added to the gasoline required for burning to make up for the loss in storing and transportation. Column 12 is taken from experiments on the road above referred to, and was maximum burning time with full carbureters and gasoline of 88 degrees gravity. In practice they found that the gravity of the gasoline was considerably reduced by absorption of the lighter products first, and that after a few fillings the heavier oil caused considerable reduction of light after burning a few hours; thus, at the start the candle power was 45, but at the end of 34 hours' burning reduced to 26.6, in one experiment.

The electric system given on line eight is the first one experimented with on the St. Paul road. The high cost given in column 6 is due to the car's proportion of storage battery, engine and dynamo, and $113 for auxiliary lamp lighting. Depreciation in No. 7 is figured at 25 per cent. for engine, 10 per cent. for dynamo, 33⅓ per cent. on batteries and 5 per cent. on wiring and oil lamps.

Line nine gives the St. Paul present electric system. Column 6 includes the car's proportion of cost of tender car and equipment, on the basis of its number of lamps, figuring on four of these cars to the 62 cars in service; also $113 for auxiliary oil-lighting equipment. In column 7 depreciation on tender car and equipment is figured at 10 per cent., and on wiring and oil lights at 5 per cent. Lamp renewals are figured in No. 10 as part of total running expenses.

In order to show the items entering into the cost of the electric system at present in use on the St. Paul road, I have thought it might be of interest to give the details. I may say right here that the rather favorable figures obtained arise from exceptionally favorable conditions, resulting from excellent distribution of equipment, heavy continuous service and careful attention to details. The results can in no wise be taken as comparable with other systems in miscellaneous service, or the same system under less favorable conditions. The data for one trip during the month of October, 1890, is:

Train of	10 cars
Running time	11 hrs.
Maximum lamp load	152
Average lamp load	87.3
Indicated horse-power hours	85.6
Water per indicated horse-power hour	57.8 lbs.
Water per trip for lighting	4,948 lbs.
Evaporation at boiler pressure per pound of coa	5.7 lbs.
Coal used per trip	868 lbs.
Lamps per indicated horse-power	10.5
Coal per indicated horse-power hour	10 lbs.
Cost of coal per ton	$2.00
Cost of coal per horse power hour	1 cent
Attendance	$5.25
Lamp renewals (3 at 40 cts.)	1.20
Oil and waste	.40
Miscellaneous supplies and repairs	.80
Coal for light	.87
Coal to haul car	2.00
Total cost per trip	$10.52
Or, per car per hour	9.54 cts.

In the summer season, when the heat tender is not in use, the total cost per car per hour would be reduced by about 2 cents or to 7.5 cents. The figure in the table, column 10, was obtained from the above for a *passenger coach*, with all lights burning, and of course differs from the average figure taken under different conditions.

V.—RELATIVE ADVANTAGES AND DISADVANTAGES OF THE VARIOUS SYSTEMS.

From what has been said it becomes evident that perfection of comfort to passengers and minimum danger from fire in car-lighting systems are attained only at the expense of much elaboration of detail and sacrifices of simplicity in operation. It would be useless, therefore, to lay down requirements for a perfect lighting system; and consideration of the subject reduces to weighing one defective system against another. Of those described we have, I believe, but four worthy of careful consideration, viz., heavy mineral oil in lamps; the Pintsch oil gas; the Frost carbureted air; the electric.

The points which should lead us to abandon a system in use, and in which we have invested large sums, are safety, better light, cheapness, convenience, advertising considerations and, we might add, in view of future possibilities, compulsion. Taking up the systems in reverse order—

The Electric may be considered adapted, in the present state of the art, to *special* service only. It fills a number of the requirements for a perfect light in a manner that no other light approaches; it is cleanly, cool, safe, allows excellent distribution and is, in fact, a luxury which is duly appreciated by the traveling public. Unfortunately, from a railroad point of view it is not such a success; it is costly, is adapted to special service only and requires great attention to details. Still, in many instances it will undoubtedly pay for itself many times over; and each railroad manager must consider for himself whether under his special conditions its use is warranted.

The Frost System.—I am bound to consider this system

still in the process of development. It has many advantages from an outside point of view; it is cleanly, the light is good, each car is perfectly independent of others for its supply of light, and it requires no external gas works. On the other hand, the first cost is excessive, the light is not cheap for running, its quality is not uniform—due to the effect of varying temperature and quality of gasoline—the apparatus is complicated and, while the system may be considered safe to the car itself, I believe the use of gasoline at various points on a large system very questionable.

The Pintsch System.—This, in spite of some serious defects, I consider the most feasible and promising attempt in the direction of safety car lighting. It is safe—as safe as any flame method of lighting can be—is cleanly and simple, is cheap in maintenance and running. It is, however, very high in first cost, and is not universally applicable, on account of dependence upon gas works. But all main-line traffic and many important branch lines can generally be provided for by this system at a moderate cost, and, under its rapid extension now taking place, it seems likely that joint gas works can be maintained by different roads at many points, to still further reduce the individual outlay. The introduction of the system has been pushed in this country lately with a high degree of success; but there are two points I cannot understand in the business policy of the company—first, why they stick to an uneconomical form of lamp, and, second, why they import from Germany their entire equipment? This last point has rather an important bearing on the question of repairs; unless they have recently changed, the German (Whitworth) system of screw threads was adhered to throughout.

Oil Lighting by Lamps.—Many of the requirements of a satisfactory car-lighting system appear to me to be embodied in the present oil system—or might be, with some improvements which are readily attainable. In no system with the exception of the electric is it possible to obtain a better or more satisfactory distribution of light, the centres being of moderate intensity; the fuel is safe to handle, and may be anywhere obtained without delay; each car is perfectly independent of others; it is cheapest in first cost and maintenance for a given amount of light; it is simple and easily taken care of. On the other hand, it shares with other flame systems the objections of giving out much heat, and the quantity of light is quite irregular and the smell objectionable when not taken care of. The ground of safety appears to be the one generally attacked; I have elsewhere stated my reasons for not believing this objection has much force. In fact, I believe it is a mistake to abandon the system until a thoroughly better one has been devised—respecting which there is at least a doubt. The possible improvements in this system should have more attention from railway officials and others. For instance, the button form of burners, of which the "Acme" is a good example, appears to solve the problem of sufficient light as satisfactorily as has been done in the other flame systems, and these burners should be substituted for the old uneconomical form.

CONCLUSION.

To conclude: the demand from the railroads a the present time appears to be principally for *more* light and a *safe* one. If my remarks to-day (and in which I have endeavored to disabuse my mind of all prejudice) lead to any conclusion it is, first, that the present oil-lighted cars are or can be made the best lighted in the country; second, that oil lighting is not, as popularly supposed, unsafe. This being the case, we should at least look over the situation carefully before jumping into an expensive and complicated system for supposed advantages.

Since the question of car heating has become a "burning" one (if you will excuse the pun), state legislators and the public have properly demanded that the railroads should experiment in the direction of something safer. This promises to be productive of good results to the public and railroads themselves, but it is to be hoped that the popular outcry will not be directed toward the lighting problem, leaving what is really a question of convenience to be worked out by those most interested—the railroads themselves.

Recent Improvements in Car Wheels.*

Recent improvements in the car wheel have been based on the necessity of keeping up with the line of progress in other railroad equipment. It cannot be disputed that with the increase in the work imposed progress was necessary. The two principal lines on which improvement could be made were safety and durability.

In explaining what we have done in this direction, I may say it has been a very great task. It has led us further than we ever thought of going in the earlier stages of the work, in putting down plants of special kinds and in changing much of our equipment and practice. I may also say that it has been costly work.

To gain perfect safety it is absolutely necessary to know all about every wheel. Not all about 1 wheel in 50 or 100, or about 49 wheels in 50. If we knew all about 999 wheels in 1,000, we would have no particular proof as to the other one. To identify each wheel and give it an individual character might be an easy task to accomplish with 100 wheels or 1,000, but to do it every single time, every day and every year, was quite a different matter.

We found a way to do it, however, and then commenced the formation of a system of manufacture that would give us all necessary information for each particular wheel. This was finally perfected and completed by us, and our wheels were then made under what we call our "System of Comparative Tests," which I give herewith. You will understand that we make these tests as a part of daily practice; they are entered on regular reports, each one proved and vouched for by the person responsible for the work.

The following are the tests for each wheel made:

Test No. 1—For Chill.—Test block, 2½ in × 6 in. This is cooled in water and examined before wheel is cast to determine if any changes are necessary.

Test No. 2—For Chill.—Test block, 2½ in. × 6 in. Allowed to cool in the ordinary manner in sand mold; broken succeeding day and examined for record of chill on wheel it represents per number combination.

Test No. 3—For Transverse Strength.—Test bar, 1 in. × 12 in.; broken on succeeding day on testing machine and record taken of wheel it represents per number of combination.

Test No. 4—For Torsional Strength.—Test bar 1 in. × 6 in.; broken succeeding day on testing machine and record taken of wheel it represents per number combination.

Test No. 5—For Hardness of Chill.—Test block 2 in. square; tested by grinding and record taken of wheel it represents per number combination.

Test No. 6.—For Shrinkage and Fluidity of Metal.—Test piece 1 in. × ½ in. × 12 in. with knife edge; measured and examined succeeding day and record taken of wheel it represents per number combination.

General Tests made Daily.

Chemical determination of carbon, sulphur and phosphorus.

One wheel from every 25 made, tested on "Pennsylvania" testing apparatus with full "Pennsylvania test," to determine all this test shows.

Examination of every wheel made by two inspectors, the first one passing on all general requirements, the second recording all individual marks on wheels and comparing and entering all tests before wheels are accepted for placing in stock or shipment.

Written reports are made covering every detail of these tests, and after being approved by the proper persons are filed for reference.

On every wheel made will be found the following number combination:

Number Combination.

Example.	Designating.
3	Molder's No.
12	Poured No.
F 26	Pattern No.
Sept. 20, 1886	Date made.
P. R. R.	Name of purchaser.

Explanation.

Molder's Number.—Showing maker of wheel and number of shop floor placed in particular position on pattern.

Poured Number.—Showing the identical location of wheel on each molder's floor. These numbers are stamped on each wheel as molded and run in regular order according to the number of wheels made.

Pattern Letter and Number.—Showing by the letter the class of pattern as to section and weight; thickness of plates that should be found and by the number the identical pattern the wheel was made from.

Date.—This being changed daily aids in forming the necessary changes in the combination.

Name of Purchaser.—With accompanying numbers to show particular service and use of wheel.

It will be noted that the number combination must necessarily be different on every wheel and that new combinations are formed in every case, which can never be duplicated. We are thus able to treat every wheel as an individual article and, by submitting each one to certain standards before acceptance, to establish its quality before shipment.

All records being entered in our books, space is left for future entries and every wheel of our manufacture received as scrap is examined, report of its condition taken, cause of failure, and all these particulars are entered in the records.

It may be asked, Is all this work necessary? To make wheels in an ordinary manner it may not be. We are fully aware that we might abandon it and for a time produce results nearly as good as with it. We would not think of such a step for a moment, however. As practical car wheel makers we appreciate more than any one could the value of the work. We know from long experience that no quality of material is good enough, and no *intention* to use care at every stage of the work is reliable enough to produce the result we want.

We can use the most expensive material and produce a wheel of the worst character; not, as a rule, of course, but as no impossibility. A wheel can be made from all Salisbury iron, a mixture of proper quality charged into the cupola, every condition in that particular be correct, but if the fuel is better than the average it does not burn as fast, the melting point is higher in the cupola, the iron hotter, the result low chill and a safe, but poor wearing wheel. If the quality of the fuel is a little below the average the opposite results will be produced, and wheels high chilled and possibly unsafe. Granted that the quality of the iron and the fuel is the best, a variation in the pressure of the blast, caused perhaps by something out of order with the blower or power operating it, will produce a similar result. Granted that all the above conditions are correct, and the iron is taken from the cupola in proper condition, something may occur to delay its immediate transfer into the mold, and the molder should refuse to cast it if not hot enough; but he may pass the proper limit, and the result be a dangerous wheel. All practical car-wheel makers know that difficulties of this kind are constantly arising in everyday practice to a greater or less extent, and that I have cited no imaginary conditions. It may be that an absolutely dangerous condition will not arise in one case out of a thousand, but that one case may cause a broken wheel with its attendant disaster. Our aim and practice is to take absolutely no chances, but guard against them all.

The main result of our work is that we know exactly what is being done, and have a known basis for inspection and tests of all kinds. The test for transverse strength is the principal indication of safety, all other conditions being correct. By this last remark I mean a great deal. Our basis for standard practice is expressed by a load of 2,800 lbs. required to break a bar 1 in. square and 12 in. long, made from mixtures used. It is possible to have this basis drop a little without incurring absolute danger, but if it should go to 2,400 lbs., danger would begin and wheels giving that result would be condemned. It is quite possible that if we were willing to take chances we might let it go to 2,200 lbs., but the principle on which we are working will readily be seen. On the other hand, we aim at maintaining a strength on this test of 3,000 lbs. for current practice. The latter amount represents the best result we could obtain in five years from the best selection of metal. Since that time we have made slow but steady progress, and have now reached 4,000 lbs. as possible in regular practice and 5,000 lbs. as a possible limit. I am quite sure we will obtain 6,000 lbs. before the close of this year. I think this is almost double any known strength for cast iron. It is very important that you bear in mind the size of the test bar from which these are obtained. It is the opinion and practice of many to base comparative results obtained from different sized test bars by computations based on the area of one bar as compared with the other. When it is considered, however, that with the decrease of the area less proportionate strength is invariably obtained, the only sure way to determine the value of strengths obtained from different bars is to rely on actual tests from each size. The distance between points at which the strain is applied is also a most important factor. For many years we based our results upon test bars 1½ in. square and 16 in. long. It might be supposed that the strength obtained from such bars would bear the same relation to that obtained from the smaller bars, tested at less distance between centres, as the area and length of one bar compared with the other; but this is not the case.

You will note that all this applies to foundry practice, and that we are able to obtain as a result full information about every wheel. The magnitude of the work can be appreciated from the fact that we can take any wheel, made for any service during the past six years, and produce a complete record for it as stated. We have over 4,000,000 separate entries and records of this kind, covering a total of 600,000 wheels made under this system in the past six years. Out of this total number of wheels there has never been one case of breakage.

You will remember that this basis of strength refers solely to transverse strength. After a considerable trial of the results that might be obtained from different irons noted for strength we made the following offer to the makers of such iron. On receipt of each car load we would take six bars from different parts of the lot, and from them make in a special test cupola six test bars of our standard size. If the average of tranverse strength on the bars gave a certain strength we would pay for it on the basis of one cent per pound for strength given on our standard size of bars. Thus for iron giving 3,200 lbs. we would pay $32, for 3,500, $35, and so on. We stipulated that the iron should be reasonably neutral; that the strength should not be due to the excess of elements other than carbon beyond the proper degree. While a number of manufacturers were very willing to undertake the work on this basis, few proved willing to continue it. Some claimed the strength was in their iron, and would be developed in re-melting. Others claimed that the use of certain ores must necessarily give value and strength, whether found in the test bars or not. For one reason or another, the majority pronounced it impracticable. They therefore stood on the ground that progress in that particular direction was impossible. We could at times secure exceptionally good results, and at other times from iron apparently the same they could not be obtained. It was only possible to consider as a practical basis a strength that could be obtained regularly, and 3,000 lbs. on the test named represented that limit. To ascertain the further possibilities was exceedingly slow work. It could only be done by the most careful and long-continued investigation. In seeking the cause we first turned naturally to chemistry. The investigation of iron from that basis afforded an unlimited opportunity; but we found that the composition of the metal was one thing and its physical structure quite a different and most important matter, on which there was practically no work done that would compare in any degree with the information at hand on the composition of the metal. We obtained from iron of like analysis totally different results in strength, thus showing how vital a question of physical structure was independent of the metal.

It is a well established fact that sulphur produces one effect, phosphorus another, manganese another, and so on; but in the metal necessary for great strength and wear our experience went to prove that carbon alone was the valuable factor.

This element exists in charcoal iron of good quality in a purer state than in any iron smelted with coal or coke. It is also found to a great extent in the combined state than in any coal or coke iron.

You are aware that carbon is found in iron principally in the combined and graphitic states. In the former it gives the qualities of strength and resistance to wear; in the latter, ductility and softness. It is therefore apparent that the former was the valuable condition to develop. On this line our work has been carried on now for some three years, and we have succeeded in getting it under control to a degree we never expected.

I would call your attention to some specimens of metal illustrating this work and showing remarkable results. You will note the test bar (1 in. × 12 in.) in which the carbon is almost wholly combined. It is perfectly white metal, hitherto supposed to be invariably brittle. This bar sustained a load of 3,200 lbs. before breaking. You will note the two samples of chilled metal showing the effect of heat on combined carbon. In one its condition has been completely changed and thrown back to the graphitic state. On another specimen you will note that the application of heat is sufficient to melt off a large portion, but has not changed the condition of the carbon at all. It still exists in the combined state at the very point when the metal was fused.

This effort to fix the condition of the carbon is for the purpose of preventing the destruction of metal in a car wheel at the point where it is burned and the life destroyed by the occurrence of brake sliding. Our work on this particular subject, or rather feature of chilled metal, is still in its experimental stages. I will not undertake to explain it now for the reason I must confess, that, while we have actually accomplished it by certain processes, there is a good deal more about the result that I cannot explain than there is that I can give good reasons for.

The study of the physical structure of iron has been to me a vitally interesting one. It has been pursued mainly by extended tests and trials on the physical basis, and in connection with microscopical work.

In cast iron we are dealing with a physical structure due to natural causes. As the iron passes from the molten to the solid state a change occurs in a few seconds of time. The gases and vapors arising from the elements contained, exist in such an expanded state that at the moment of solidification of the metal they cause the cell structure. The adhesion of the cells to each other and their inherent strength is what gives to the iron its strength as a whole. It will not be possible to dwell further on this particular matter on account of the time that it would necessarily take.

My attention was early drawn to this work to the fact that at best we could only produce a car wheel with all the elements of safety, but that it would still be a product of the foundry, and not a mechanically perfect article. Apparently this was not altogether a question for the wheel maker. If the users of car wheels saw fit to take something not mechanically perfect, it was evidently their affair and not ours. So said many at that time, and so say not a few to-day. Chilled iron is not an easy thing to work in a machine shop. Very few tools were constructed to deal with it, and so far as car wheels were concerned the tools procurable did the work of making the wheels true and round after they had been placed on the axle. As car-wheel makers do not put one per cent. of the wheels they make on axles, it followed that the users would have to do this work if it was done at all. We decided to take the whole matter up ourselves for two reasons: first, because the available means were expen

* By P. H. Griffin, President New York Car Wheel Works, Buffalo, N. Y. Read at a regular meeting of the New York Railroad Club, Feb. 19, 1891.

sive and impracticable for general use, second, because what little experience we had gained in this particular work proved conclusively that by far the greater part of the labor involved in making the wheel mechanically perfect was an element entirely under the control of the car wheel maker. It took us several years to design, build and make perfect machinery for doing the work. A description of the results will perhaps interest you more than the methods by which they were obtained. The principal tools used are boring mills, grinding machines and balancing machines. We found that face plates of boring mills as usually constructed, could be sprung from one-sixteenth to one-eighth of an inch; this on account of the slots holding the bars operating the dogs. This was corrected and chilled reamers with 24 in. of cutting face substituted for the narrower steel cutters; we found that the exercise of great care in this particular decreased the work of finishing the wheels materially.

The grinding machine was of course the all-important affair. It was constructed to treat the wheels without placing them on axles. The general design of the machine is illustrated by the drawings herewith. Bed plates are shaped like the letter "H;" across the centre are three standards, carrying two 6-in. shafts. These shafts abut in the centre standard and thus enable each end of the machine (which you will note is double) to operate independently. Each shaft has on its projecting ends a heavy expanding mandrel, with keys worked in and out by means of a nut at the extreme end. There are four grinding attachments, two at each end of the machine. These can be set at an angle or operated on any wheel from 20 in. to 50 in. diameter. The car wheel is rolled in the usual manner on the small track shown, and the truck moved under the mandrel, the latter entering the bore of the wheel; by turning the nut the keys are expanded, the wheel raised a little, centered and secured in position. The truck is then removed. One of the grinding attachments is adjusted, the automatic feed set in operation, and then the opposite one attended to in the same manner. The operation of the machine is automatic from that time until the wheel is ground true. The attendant is free to place a wheel on the opposite end of the machine in a similar manner. As a matter of every-day practice 50 wheels are finished in ten hours. The machine is very heavy, intended for rapid and effective work, and all its parts are thoroughly constructed; it weighs about 13,000 lbs. The best evidence of its value and practicability is shown by the fact that we have already placed over 150,000 "machined" wheels in service.

After the wheel is ground it is removed from the machine and tested for balance. This is done in the usual manner by the use of parallel ways. An expanding mandrel with projecting ends of the same size is inserted in the bore of the wheel, centered and tightened, and the wheel placed upon the ways. After the heavy part of the wheel is located a scale bar is adjusted on the end of the mandrel, and the heaviest part of the wheel brought horizontally in line with this bar. The amount the wheel is out of balance is determined and the necessary weights added.

The results obtained from the use of "machined" wheels are very apparent. Some of the leading trunk lines use them exclusively, and have been able to stop brake-sliding almost completely. The increase in mileage obtained from them is very marked already, and as time goes on the improvement will undoubtedly continue.

There are some important features of value in the work that cannot be questioned. If perfection is necessary in every kind of mechanical service there is no reason why this particular branch can be excepted. The objection is made by some that a part of the wearing surface of the car wheel is removed in doing this work. I do not think the material in a car wheel over and above the line of perfect rotundity adds anything to its life. In brake service it certainly has a disastrous effect. When the brakes are applied to a wheel that is not round brake-sliding is sure to result. It is not, however, necessary for me to enter into a discussion of possible benefits to be derived. We started this work with the object of producing a perfect car wheel, and believe we have fairly accomplished what we started out to do.

DISCUSSION.

Mr. WHITNEY: I can second some of Mr. Griffin's remarks in regard to the manufacture of wheels. Within the last five years it has demanded a great deal more attention than it has ever before. And I think to-day you railroad men will find there has been a very great improvement in the manufacture of wheels. One of the most valuable steps in that movement was that which was inaugurated by the Pennsylvania Railroad in the inspection of wheels, demanding that they should stand certain tests, which have come into general use, and have made a demand upon the wheel makers to make a very much better article than they did before, and the community is getting the benefit of it.

We believe that very largely the question of wear depends on the materials of which a wheel is made, and it does not always follow that two irons analyzing exactly alike will produce the same wheel, neither does it follow that two rails made from the same chemical analysis will give the same wear. In our business we have long adopted the rule (in fact, it has been the rule ever since we have been in the business), to examine all iron that comes into our yard. We never purchase a pound of iron until it has been fully tested, and then every shipment of that iron is tested by itself in special cupola, in special tests, to ascertain all its qualities. When the wheel is made we have not as elaborate a system as Mr. Griffin to determine each wheel, and yet I presume we know about as near as can be about each wheel. Every individual wheel that goes out of our establishment has to pass 27 inspections before it leaves the shop; if it fails on any one of those inspections, it is condemned. In the matter of hardness of the chill we have a little different method than has been developed by Mr. Griffin. It is well-known among wheel makers that drilling is a very unreliable test. In our establishment we have, in the last few years, introduced a system which was devised by Professor Turner, of Birmingham, England, by which the amount of weight required to produce a certain scratch on the test piece is noted, and we find that it is not always the hardest wheel that is the best wearing wheel. A hard wheel will run up to 65 or 70 deg., as indicated on this instrument, but a good wearing wheel is something like 55 or 60 deg. of hardness.

We also test for transverse strength. Our test bar is 2 in. square and about 15 in. long, supported generally at 12 in., the strain in the middle. Then by calculation we get at the strength per square inch. We do not take a square inch bar, because the metal is apt to be too close. Taking 2 in., it will be sufficiently uniform to get a good result. Our wheel mixture tests from 8,000 lbs. to 10,000 lbs. per square inch. We are not satisfied with less than 8,000, and it runs to 10,000.

We are very much gratified to find that in service we have very seldom to hear of any failure of our wheels, and there is an illustration of the great value of using material of this character. I have examined into the matter very recently, and find that out of all the wheels which we have put out in 1889 and 1890—that is, for locomotives, passenger cars, freight cars, street railroads, electric motors, mining cars, and all other kinds of service—out of 117,000 wheels made in that time and put in service, we have been called upon to replace, from all causes (and a good many of the cases were matters of question), 70 wheels, about .0006 of our make. It is simply because we have used such great care in selecting the materials. It is very expensive material; it is not material that can be bought for nothing.

Now, as regards roundness, which is a very important matter, and which Mr. Griffin has so admirably accomplished by his means of grinding a wheel, we have come to the conclusion that it is very much better to make the wheel perfectly round in the first place and not require any grinding, and by our process of manufacture, which I presume you are all familiar with, we have obtained such success that you can go into our yards at any time and apply the absolute tests of a true ring upon the cone of a wheel, and you will find that in not five wheels in a hundred you can put an ordinary visiting card between the ring and the wheel anywhere. They are just as truly round as it is possible to grind them.

We not only obtain a perfectly round and smooth wheel, but they are all exactly the same size. When we used the ordinary chill, we would frequently have in the same day, in the same chill and out of the same ladle of iron, one wheel $\frac{1}{2}$ to $\frac{3}{4}$ of an inch larger in circumference than the other. But in our present mode of making wheels we find that brought to the lowest possible difference. Some of you may have seen the statement, which we published some time ago, that, out of 10,000 wheels which we furnished in one order, we made a thousand wheels a month; and running through all this time, with all the variations due to ordinary foundry practice, out of these 10,000 wheels, in more than 9,750 of them the extreme variation was not $\frac{1}{32}$ of an inch in diameter from the largest wheel to the smallest. Those wheels have been running now for two years, and there is not a wheel reported in any way defective and no complaint has been made. We never ground them; never had any necessity to. Now, if we can obtain that roundness and that uniformity, which is so important, without any extra expense, all the railroad companies get the benefit of it.

The CHAIRMAN: Mr. Snow, we would like to hear from you on this subject.

Mr. SNOW: I think the ground has been pretty well covered by both Mr. Griffin and Mr. Whitney. I indorse pretty much all both gentlemen have said on the subject. What Mr. Whitney says about the depth of chill and roundness of wheel I indorse fully, as we get the same results that he gets with a cold water chill, which gives perfect roundness in all the wheels. I don't think there is a variation of $\frac{1}{64}$ of an inch in the many thousand wheels we make as to their roundness.

Mr. WHITNEY (in reply to a question about fins on the treads of wheels made in contracting chills): With regard to that, I will simply state the kerfs in the chill that we use are not large enough to make a fin. The kerf is about $\frac{3}{64}$ of an inch in width. It is not sawed. The fin referred to is caused by the necessity of sawing the kerfs in the chill, and it is almost impossible to get a saw that will make a kerf much less than $\frac{1}{32}$ of an inch. But we cast our chills with a slot that is only $\frac{1}{64}$ of an inch in width; and that, I presume, most of you know is made by inserting in our mold sheets of asbestos paper. We first placed two sheets of asbestos paper, side by side, in the core. The asbestos paper, you know, must have some body to it to make a paper of it. When it is exposed to a high heat the substance that forms the body is destroyed by the heat; there is nothing left out the fine powder of asbestos, which, as the chill is manipulated, falls out. We found by placing two sheets of this asbestos together the kerf was not large enough; the segments would come together too close. I then tried three sheets of asbestos paper. Those three sheets made just about the right thickness, but the inner sheet, not being exposed to the hot metal, did not have its body material burned out of it, and there it remained as a thin sheet of paper in the kerf, which was a little troublesome. But I got over that. I place now between these two sheets of asbestos paper a sheet of blotting paper of the proper thickness. Now, that piece of blotting paper is hermetically sealed between the two sheets of asbestos paper, and when the molten metal flows in each side of the asbestos it envelops the blotting paper in an air-tight cell, like a piece of wood in a charcoal bed, and the blotting paper is converted into charcoal, pulverized, and drops out, leaving the kerf just $\frac{1}{64}$ of an inch in width. Now, in practical application, before we pour a wheel we have a kind of varnish which we wipe over the chill with a brush. This preparation makes the chill perfectly clean, and covers those fine kerfs so completely that the iron does not run into them, and when the wheel is cast you can see the lines of the kerfs, but you don't feel the kerf; there is no ridge.

The First Iron Bridge.

The illustration shown herewith is from a photograph of what is said to be the first iron bridge ever built. The photograph was sent by Mr. Henry C. Simpson, of Horschay, Shropshire, England (Member Iron and Steel Institute), to Mr. T. B. Lee, Chief Clerk American Society of Civil Engineers. Mr. Simpson says that this bridge was opened for traffic in 1779, and is still a most serviceable structure. It has given the name to the town of Ironbridge in which it stands. The span of the centre arch is 100 ft., and the weight about 378 tons. The ribs were cast at Coalbrookdale, each in but two segments. Robert Stephenson said of the structure: "If we consider that the manipulation of cast iron was then completely in its infancy, a bridge of such dimensions was doubtless a bold as well as an original undertaking, and

CAST IRON BRIDGE—OPENED FOR TRAFFIC 1779.

the efficiency of the details is worthy of the boldness of the conception."

One lesson from this structure is that a properly designed iron bridge is good for at least one hundred years of life.

Investigation of the Tunnel Disaster.

Coroner Levy of New York City on Wednesday of last week began the inquest on the death of the victims of the collision of Feb. 20. The jurors were: Ex-Mayor William Wickham; John D. Crimmins, contractor; Andrew Mills, President Dry Dock Savings Bank; G. G. Williams, President Chemical National Bank; J. L. Mott, President of the Mott Iron Works; Gustave H. Schwab, of Herman Oelrichs & Co.; David R. Willis, Schuyler Warren; Isaac V. Brokaw, clothier; Isaac Hamburger, Julian M. Elliott, and J. Seaver Page.

The first testimony was that of Engineer Fowler of the New Haven passenger train, whose statement was substantially the same as that given in the *Railroad Gazette* last week. He said explicitly that he took up his position on the fireman's side of the cab on approaching Seventy-second street. William C. McManus, operator at Seventy-second street, 22 years old, 3 years' service as signalman, told his story in a straightforward manner. The night operator had pulled off the signals for the empty train before he came on duty. After it had passed McManus set the signals at green and red respectively. As the empty train was going slowly, and as in such cases it occasionally becomes necessary to order a following train to push the stalled train over the grade, McManus called in a track walker, John Jones, who happened near, thinking he might need a messenger to send to the engineer of the next train. When the New Haven train passed Fifty-ninth street the empty train was between Seventy-second and Eighty-sixth; as the New Haven train was coming rapidly, McManus remarked to Jones, that on account of the fog, the engineer might overrun the signals, and called Jones' attention to the fact that the levers were both set against the train. The New Haven train went right on, and McManus at once wired Eighty-sixth street to look out for it. Then he sent Jones to see if the lamp in the signal had accidentally become extinguished, and notified Fifty-ninth street to hold all trains. Jones came back and said the signal was burning all right and showing red. Fowler had testified that he heard no gong ring when he passed the home signal, but that he did hear it ring, for the first time in his life, when his train was pulled back to the yard after the collision. When asked to explain this, Mc- Manus said:

"They might have been going too fast, when they went up, to make the bell ring. When they came back they ran slow and were sure to make the bell ring. Going

past very fast, the hammer on the gong would not have time to spring back before it would be struck again."

McManus testified that the wires to the distant signal sometimes became elongated, so that the signal did not stand squarely either in the danger or the safety position, but that the connections with the home signal were of gas pipe. The signals are inspected two or three times a week. The cases of the Sykes locks have holes in them, through which a lead pencil can be inserted for the purpose of unlocking the levers in case of derangement of the electric locks.

The conductor of the empty train testified that none of the lamps in the cars were lighted. The police surgeon was examined as to whether the victims were burned to death or died from injuries received in the collision. There was no doubt in his mind that the immediate cause of death was fire.

On Friday Conductor Lahey, of the New York, New Haven & Hartford train which left the station at 9.05 a. m., two hours after the collision, testified in regard to a narrow escape from a rear collision by his train at the same station at which the disaster occurred. This nine o'clock train ran through the west (single track) tunnel, on account of the blockade, and was detained several minutes at Fifty-third street and at Fifty-ninth street. At the latter place the rear brakeman went back to flag a following New York Central passenger train. Seeing it come to a stop he returned to his own train. While the New Haven train was running between Seventy-second and Eighty-sixth streets, Lahey, who was on the rear platform, heard a rumbling, and, as he was moving slowly, sent back his brakeman, who had gone but 200 or 300 ft. when he found the following train was so close that he at once placed a torpedo on the track. This stopped the Central train, which, it appears, had run past the Seventy-second street home signal, which was at danger. It is also said that a lantern in the hand of a special watchman stationed at this signal was disregarded; and the brakeman of the New Haven train also ineffectually tried to attract the engineer's attention with his red light. The Central engineer, Rigney, claims that his fireman told him the Seventy-second street signal was all clear. On reaching Eighty-sixth street, he was stopped and told that he had been reported for disregarding a signal. He claims to have heard no gong. His speed is not stated, but it was probably very moderate.

John Jones, track walker, who has been on this section over 20 years, corroborated the testimony of McManus. The fog was not so dense but that Jones could see the home signal easily at a distance of 175 ft. John Kelly, section foreman, was walking southward when the New Haven train passed the distant signal at Seventy-second street, and, the fog being dense, turned around and looked at that signal just before the train reached it, and he testified that it was green. He entered a manhole to get out of the way of the train, and, when he came out, again looked at the signal, and it was still green.

Edward J. Breen, operator at Eighty-sixth street, had just come on duty when McManus reported that the New Haven train had run past the signal. Both Breen and the night operator, Ames, read the message, and both rushed to the window to shout to the engineer of the empty train, which was just passing. Breen was asked why he did not, on receiving this message, throw his distant signal to danger, and answered in substance that he did not think the empty train had fully passed it. Breen had heard the gong of his home signal ring when trains had run past it set at danger. It was 30 ft. away from him and separated by passing trains.

On Tuesday of this week additional evidence was taken concerning the fire in the cars. A foreman of car cleaners testified that immediately after the crash he saw redhot coals on the floor of the day coach and the woodwork burning. He thought that oil which had been spilt from lamps materially aided and hastened the spread of the flames.

General Manager C. H. Platt said he had no ground for a reasonable doubt that the signals stood at danger when the New Haven train passed them. From tests made by him he concludes that the gong would not respond to the track lever when the latter was operated by a train going 25 miles an hour or faster. The gong was not erected for use as a warning to trains going at such speed, but to help an engineer locate a home signal when, in consequence of a cautionary distant signal, he was feeling his way along slowly. Mr. Platt had no personal knowledge about Rigney's conduct or his excuse, but had the evidence of two men who saw Rigney run past the danger signal. The signals in the side tunnel are placed on the left of the engineer, so as to make them uniform with those in the middle tunnel; there is no practical way of placing the latter on the right of the engineer. Questioned about the feasibility of making one block of the whole tunnel, Mr. Platt said the traffic was too dense, and that the safeguard now afforded by the track circuit would then have to be given up. These circuits, the whole length of the blocks, are now utilized to lock the levers. During the past 15 months six engineers have disregarded signals, including the two on Feb. 20. The number of passengers through the tunnel annually is ten millions, and this is the first accident to any one of them since 1882. On Jan. 2 of this year an engineer, who ran by a home signal, reported that the gong did not ring. This led to the investigation above referred to, and the substitution of larger gongs.

On Wednesday President Depew, of the New York Central, testified. He said the company sought for the best system regardless of expense. The tunnel would have been lighted long ago if that would have proved an effective remedy. Making an open cut seems impracticable. "I have to go to Albany four or five times a year to keep the tunnel from being sealed hermetically," at the demand of property owners on the street above. Dr. Depew had his doubts about the safety of continuous steam-heating systems. A pipe in his private car burst, once on a time. "The pressure to carry steam through a large train has to be very great." President C. P. Clark, of the New York, New Haven & Hartford, was called to the stand, but refused to discuss the legal question of his road's relations to the New York state law concerning heating of cars. His road had made a study of heating, and had not adopted steam heating. The company had come to the decision that the Baker system of heating, which had been used by it for 25 years without accident, was better than steam heating.

Anton Hermanson, a signal repairer, testified that on the day before the accident the signals were all in good working order, and that two hours after the wreck he had examined them and found them to be all right.

Tie Plates and Spikes.

In the *Railroad Gazette* of Oct. 3, 1890, was given a description of the Shoulder Tie Plate, which had then been in experimental use for about a year, under extremely heavy freight traffic, at the Harsimus Cove terminals of the Pennsylvania Railroad. We are informed that it is now in use on eight different roads. This is a plate of steel, 5¼ × 9 × ¼ in. It has a shoulder stamped up to take the bearing of the rail flange on the outside. The plate is slotted for the spikes in such a way that tight spiking can be done in spite of some variation in the width of the base of the rail.

When the description was published last October a great saving of the ties was already noticed. These have to be turned every year, and renewed every two years on account of the heavy tonnage passing over them. Those to which the shoulder tie plate had been applied a year showed no cutting; the spikes were tight and the gauge true. A little time ago another examination was made to ascertain the condition of the spikes. Fig. 1 shows spikes that have been in the track 18 months

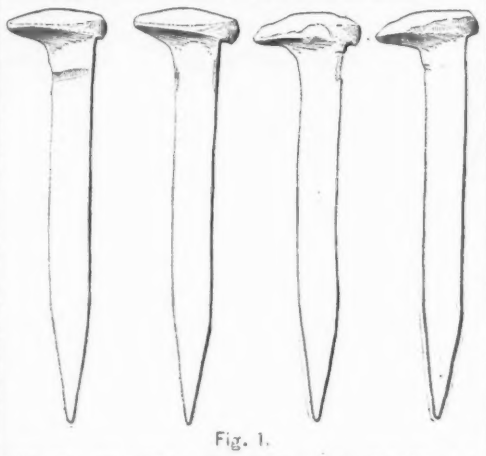


Fig. 1.

with the tie plate. It will be seen that there is scarcely any cutting. Fig. 2 shows spikes that were in use in the same tracks and under exactly the same conditions without the tie plate. The wear is saved not only by the shoulder, which takes the thrust,

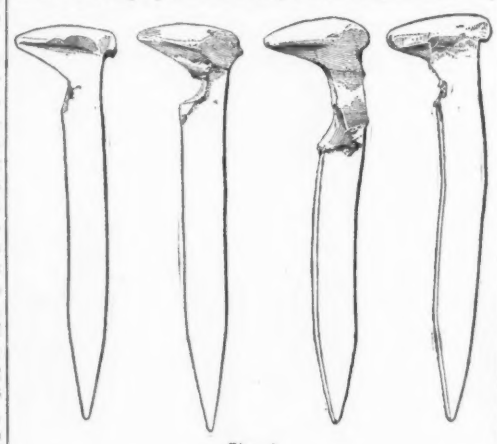


Fig. 2.

but because the rail is held tight on its seat and kept from churning up and down.

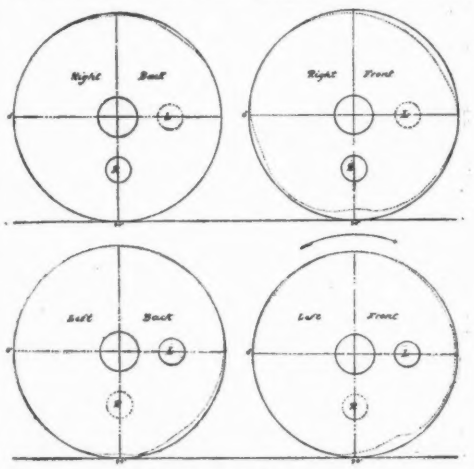
The economy of tie plates is especially apparent where ties are worn out fast under heavy traffic, but the additional security is not peculiar to any kind of service. The broad bearing and the use of the inside spikes, as well as the outside ones, to prevent rails spreading or turning, are advantages that will, be realized even where the ties are not very rapidly destroyed, and where it is not of so great importance to save them.

Counterbalancing Locomotives.

At the February meeting of the Western Railway Club the discussion of Mr. Barr's paper on this subject was taken up.

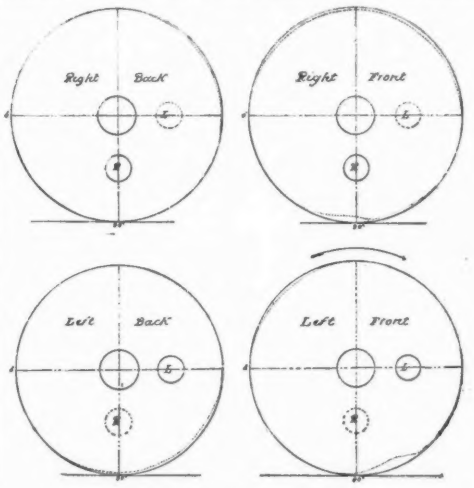
Mr. LEWIS: About a year ago, when this subject was before the club, I noticed a reluctance on the part of the members to enter into the discussion of the flattening of tires in certain localities, particularly where they had a sandy roadbed. I have made a device by which I can take a perfect picture of the flat spots and their location. The instrument consists of a revolving disk attached to the tool post of a driving-wheel lathe, and geared to the head-block of the lathe, making the same revolutions as the face plate. The pencil bar attachment is first set at the inside of the tire, with the point of the pencil at zero, or the centre mark on the paper. Then by moving the pencil bar to the tread of the tire, and allowing the lathe to make one revolution, it describes a circle the radius of which represents the thickness of the tire, and at the same time locates accurately the position and depth of the flat spots. The diagrams presented are from engines of the same general dimensions as the engine cited by Mr. Barr in his introduction of this subject; but while the total weight on the drivers in this engine is but 54,500 lbs., or 500 lbs. in excess of the engine mentioned by Mr. Barr, the diameter of the cylinder is 18 in., that of Mr. Barr's engine being 16.

Mr. Barr's paper shows the pressure against the pin,



Engine No. 8—Passenger.
Mileage between turnings, 75,152.
Miles per 1-16 *in. wear*, 18,788.

normal to a line passing between the pin and the wheel, tending to produce rotation. I presume this applies to an engine traveling at the speed of 40 miles per hour, and is computed from indicator diagrams at that speed, with the engine working at a 6-in. point of cut-off. But there are other conditions that the engine is subjected to a great many times each trip that may have considerable bearing on this question; for instance, the pressure applied at starting, when the effect of centrifugal force is absent. At such times when the 100 degrees point is at a point of contact with the rail, the steam in the left-hand cylinder will be exerting a pressure of about 32,169.6 lbs. in a 16-in. cylinder; while with the 18-in. cylinder, as cited in these diagrams, the pressure exerted would be 40,713.6 lbs., or 8,600 lbs. in excess of Mr. Barr's engine. These, you will remember, are the conditions before the engine has accumulated sufficient momentum to generate any centrifugal effect. You will admit that, as the piston



Engine No. 11—Passenger.
Mileage between turnings, 46,443.

approaches the end of the stroke, the momentum of the reciprocating parts is overcome by the compression in the cylinder, and that the weight of these parts on the pin decreases gradually from the vertical point until at the horizontal point it is entirely neutral. Not so, however, is the weight which would be applied in the wheel to counterbalance the reciprocating parts. There is no instant of rest or compression in the cylinder to retard this; it goes on exerting its centrifugal effect almost uniformly during the entire revolution, and when the centre of gravity of the counterbalance reaches a point represented by 315 degrees on these diagrams this weight is free to exert a leverage, the centre of the axle acting as the fulcrum, thereby increasing the tendency to slip when the 100-degree point is at the point of contact with the rail. There is no other point in the revolution of the driver where the centrifugal effect tends so greatly to produce a slip as at this point, and this force, acting as it does in conjunction with the steam pressure applied, tends to produce at this point the slip in the driver described.

You will notice the remarkable uniformity of the loca-

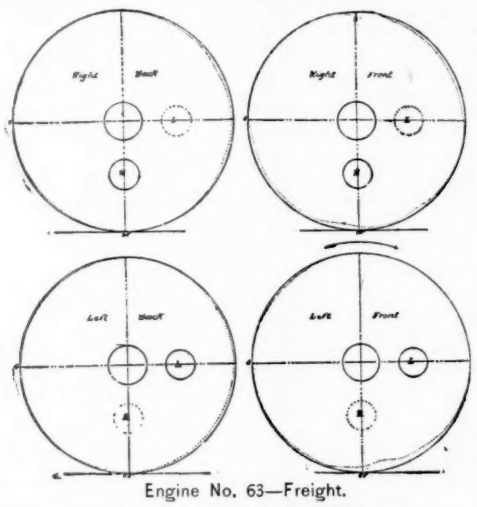
tion of the flat spots on all these diagrams presented. The great extent of flat spots, located as before mentioned at the 100-degree point, is on the left-hand forward driver wheel. The absence of a corresponding flat spot on the other drivers proves conclusively that these spots are not produced by the slipping or skidding of the drivers, and the lesser depth of spot on the right-hand driver would also indicate that the centrifugal effect tends to lighten the weight on this driver, reducing the friction and the consequent abrasion of the metal; while the angularity of the left-hand main rod, with the pressure before mentioned, increasing as it does the pressure of the left-hand tire at this point on the rail, would explain the increased depth of the flat spot at this point on the left-hand wheel.

MR. WM. FORSYTH: Were the right and left wheels worn alike?

MR. LEWIS: No; and you will notice the difference in the extent of the flat spot on the right and the left wheel. The location of the flat spot is uniform in all these diagrams, but you will notice that there is no case where the spot is exhibited on all four wheels alike.

MR. WM. SMITH: Your four wheels are not counterbalanced alike.

MR. LEWIS: Oh, no, because you have the weight of the main rod and the difference between the main rod

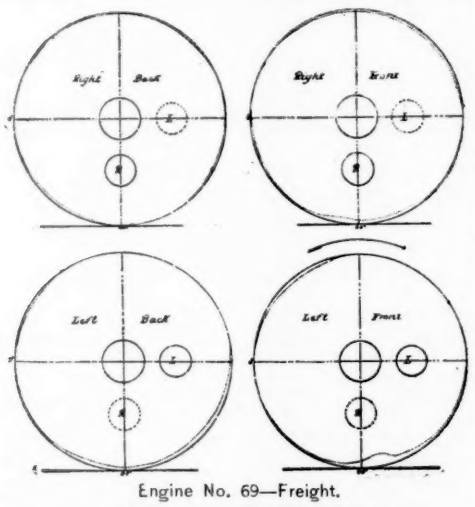


Engine No. 63—Freight.

Mileage between turnings, 49,958.

and the weight of the side rod as against the front and back wheels.

MR. GIBBS: Mr. Barr regrets very much that he cannot be here to answer some of the questions which he thought would be brought out by his paper. As I understand, it his explanation of the phenomenon is not exactly as Mr. Lewis interprets it; Mr. Lewis appears to conclude that, as the spots on the drivers are not of the same dimensions, they cannot be produced by slipping, but are rather the results of variations in the weight on rails and consequent friction and abrasion: those variations being the results of interactions of the counterbalance and angularity of main rod. Now, if you will turn to diagram on sheet No. 2 of Mr. Barr's paper, you will find that the spots occur in general where the total weight of the four drivers on rail is least, prominently, between 70 degrees and 170 degrees. Then turning to sheet No. 4, it will be seen that between these angles the average coefficient of slip is greatest; it would, therefore, seem that if any slip occurred in the revolution, it would at least be found between these angles In point of fact, it is found here. Again, turning to table No 1, it will be noted that the weight on drivers between these angles is not the same for all, the greatest weight being on the left-hand side of engine and the least on the right back driver, where it will, perhaps, average below 10,000 lbs. We might, therefore, reasonably expect, when slip did occur, that the abrasion would be proportional to the weight on each wheel, allowing all to slip through the same angle; the facts in diagram No. 1 appear to bear out this theory and Mr. Barr's conclusion. Some irregularity in the position and extent of the spots are not readily accounted for by the diagrams; but the differences are not in my mind sufficient to vitiate the partial theories advanced; the flat spots will tend to graduate indefinitely into one another and be extended beyond the limits where the coefficient slip was great enough to cause them to appear, for a variety of causes, among which may be mentioned the effect of compression, the condition of the track and the lost motion and spring in rods.



Engine No. 69—Freight.

Mileage between turnings, 35,960.

MR. WM. SMITH: It would appear to me that we never make any allowance for the forward wheels being heavier than the back wheels. Within the last six months we have had on our road only two engines with tires worn flat. We do not make any difference in counterbalancing the front or the back wheels, for this reason, that we consider that the load of the engine will do the counterbalancing of the reciprocating parts.

MR. DELANO: I am interested in this subject from the standpoint of a track man, and I suppose that most of the members know that a good many rails are injured by engines. There have been cases where several miles of rails, which were in good shape, have been removed on account of kinks caused by the effect of the counterbalance, and I think it is a fact that 90 per cent. of the rails on ordinary main lines has to be removed long before they are worn out, on account of defects of this kind; that is to say, only about 10 per cent. of the rails on the main line actually wears out. I know that on the Chicago, Burlington & Quincy we had some very fine rails that had been in use nine and one-half years, and when they were taken out I measured them, and there was less than $\frac{3}{32}$ of an inch worn off of the top of the rail. There is practically no rule which is enforced about hauling new engines over the road, and those engines go with their full counterbalance weights in the wheels. Now, if the counterbalance can do the damage that has been mentioned with the reciprocating parts and connecting rods attached, how much greater damage will be done if these dead engines are hauled at the rate of 30 or 40 miles an hour in the middle of a train without these parts. I know a great many rails have been found very much bent, that I think were bent by the dead engines with uncompensated balance weights.

MR. POTTER: We have experienced some trouble, but not in the way Mr. Lewis stated it. We found our principal trouble on the right-hand main driver of our consolidation freight engines, while Mr. Lewis found it was on the left-hand main driver. I conclude that it was caused by both counterbalances being above the centre and exerting the lifting force which has been spoken of here; furthermore, to the wheel is added the additional weight of the pressure from the piston, and thus the weight on the drivers at one point is so much less that the wheels slip at that point, causing the metal to be worn from the tire. We have had quite a number of cases of this kind. I am rather surprised to learn that others have found in their experience that the wear is principally confined to the left wheel instead of the right, as I have found it.

Mr. D. L. BARNES: Does this grinding action take place at speed or at starting?

Mr. POTTER: I think it occurs when the engines are run at a high rate of speed.

Mr. BARNES: Do you find your eight-wheel engines wear the same way?

Mr. POTTER: We are not now running any eight-wheel freight engines, but when we did, we didn't notice wear to any great extent—never enough to cause any comment.

MR. GIBBS: In regard to the question whether wear occurs at starting or at speed, I believe the peculiar defects under discussion are produced mainly at speed; their variation in amount in different wheels would indicate this. Besides, the difference in weight on rail we plotted only holds good at speed. In this connection I would say, to answer a question raised as to Mr. Barr's figures, the results given in table No. 1 are based on actual indicator cards taken under normal working conditions.

MR. BARNES: We have positive proof that wheels slip at starting; you can watch an engine starting and see the wheels turning round four or five times. It must be that there is some slip at starting, and also at speed. It occurs in both; whatever we may think about the slip at speed, we know it is there in starting.

Subsequent to the meeting the secretary received the following notes on counterbalancing by mail from Mr. John Hickey:

The deductions from Mr. Barr's paper on counterbalancing the driving wheels of locomotives, that the reciprocating parts and counterbalance be as light as possible, is a conclusion, I believe, he will find little opposition to. The facts are that we would have a less number of flat spots on driving-wheel tire, less wear of tire and rail per mile run, and much less destructive forces to machinery and track, if all machinery located on a locomotive below the springs was much lighter than usual. This is one of the important features in locomotive construction that should receive more serious attention. Driving wheels, driving-wheel axles, boxes, eccentrics, etc., all should be made lighter than are now used. I do not assume that the material used in these parts is any stronger than necessary, but a much lighter material of equal strength can be introduced. Here we might consider the policy of using 3 and 4-in. thickness of tire. Are we gaining anything when we consider the difference in wearing qualities of the two thicknesses, and the extra rigid weight involved by the extra thickness of tire? At all events, the question of weight of machinery located on a locomotive, where it has not the advantage of being cushioned to the rail with springs, is worthy of deepest consideration.

Train Accidents in the United States in January.

COLLISIONS.

REAR.

1st, on Delaware, Lackawanna & Western, at West Paterson, N. J., a westbound express train was turned on to a siding at a switch which it is thought had been maliciously tampered with, and collided with some freight cars. The entire train was derailed, the engine being thrown over on its side and a combination baggage and smoking car and several freight cars being badly damaged. The cab of the locomotive took fire, and, together with a portion of the baggage car, was burned up. Two trainmen killed and two injured.

2d, on Philadelphia & Reading, near Lebanon, Pa., a freight train broke in two and the rear portion was run into by a following freight, disabling the engine and damaging caboose and several cars. One trainman injured.

2d, on Manhattan Elevated road, at Eighth avenue and 155th street, New York City, a passenger train ran into the rear of another passenger train in a dense fog. The rear car was damaged and the tender of the locomotive collapsed, killing the fireman.

2d, on Manhattan Elevated road, at Eighth avenue and 131st street, New York City, a passenger train ran into the rear of another passenger train during a dense fog. Engineer slightly injured.

2d, on New York, Lake Erie & Western, at Ridgewood Junction, N. J., a standing freight train was run into at the rear by an empty passenger train, wrecking engine, caboose and 2 cars. The wreck caught fire and was burned up. It is said that a wrong signal was given to the passenger train by an intoxicated signalman.

3d, on Louisville & Nashville, at Galloway, Tenn., a freight train ran into another freight, wrecking engine and four cars, and injuring an engineer.

4th, on Detroit, Grand Haven & Milwaukee, at Linden City, Mich., a disabled passenger train standing at the station was run into at the rear by a freight train, damaging the rear sleeper and the engine and a box car. Engineer and fireman injured. The freight was flagged, but it appears that the engineer failed to observe the signal until too late to avert the collision.

6th, on Duluth, South Shore & Atlantic, near Eagle Mills, Mich., a passenger train ran over a misplaced switch and into a log train standing on a siding, doing some damage and injuring a passenger.

6th, night, on Cincinnati, New Orleans & Texas Pacific, at Wilmore, Ky., a passenger train ran over a switch which had been maliciously misplaced, and the light of which had been extinguished, colliding with some freight cars standing on the siding, a number of which, together with the engine, were damaged. Engineer slightly injured.

8th, at East Buffalo, N. Y., a West Shore freight ran into the rear of a New York Central & Hudson River freight on a curve where the view was obstructed by a high fence.

8th, on Chicago, Burlington & Quincy, at Chicago, Ill., an Illinois Central stock train standing on the main track was run into at the rear by a Burlington stock train, wrecking the caboose and 1 car. Two drovers riding in the caboose were killed.

9th, on Illinois Central, near Fort Jefferson, Ill., a freight train ascending a grade broke in two, and the rear portion ran back and into the head of a following freight, wrecking engine and 5 cars. Two trainmen injured.

10th, on Chicago & Indiana Coal road, at Brazil, Ind., a special engine ran into the rear of a freight train, disabling it, and derailing 6 freight cars. A fireman was fatally injured.

10th, on Pittsburgh, Ft. Wayne & Chicago, at Toledo Junction, O., a freight train which had broken in two was run into at the rear by another freight. Six cars loaded with oil were ignited and burned up. Engineer and fireman injured by jumping, the latter seriously.

13th, on Pittsburgh, Fort Wayne & Chicago, near Woodstock, O., a freight train ran into the rear of another freight, wrecking engine and 12 cars. Twelve cars were burned up. Three trainmen injured.

19th, on Lehigh & Lackawanna, at Brodhead, Pa., a southbound passenger train ran over a misplaced switch and into some freight cars standing on a siding, damaging a number of freight cars and the locomotive and derailing several coaches.

19th, on Lehigh Valley, at Sayre, Pa., a passenger train ran over a misplaced switch and into a locomotive standing at a water tank. The engineer of the latter, who, endeavoring to lessen the shock of the collision, had put on steam, was thrown out of the cab. The engine ran uncontrolled 2 miles to Athens, where it collided with a coal train. Three engines and a number of freight cars were badly damaged. A fireman and a brakeman were killed and an engineer injured.

22d, on Boston & Maine, at Scarboro Beach, Me., a local passenger train was run into at the rear by an empty engine during a dense fog. The baggage car, which was at the rear of the train, was badly smashed. The baggagemaster was killed and a fireman, an employé and 2 passengers were injured. The empty engine usually ran ahead of the passenger train, and the runner on this occasion forgot that the passenger was ahead of him. There was a dense fog at the time.

22d, on New York & New England, at Hopewell Junction, N. Y., a passenger train ran into the rear of a freight train which had stopped to do some switching, wrecking engine, caboose and 6 freight cars. Fireman injured by jumping. There was a dense fog at the time.

25th, 9 a. m., on New York Central & Hudson River, near Peekskill, N. Y., a passenger train ran into the rear of a freight train during a heavy snowstorm. Engine, caboose and 4 cars badly damaged.

25th, night, on Georgia Pacific, at Cook's Springs, Ala., a freight train ran into the rear of another freight, doing considerable damage. A brakeman was killed and the engineer and firemen were slightly injured.

25th, on Denver & Rio Grande, near Howard, Colo., a freight train broke into three parts, and in a collision between them a number of cars were wrecked. A brakeman and 2 tramps were badly injured.

27th, 6:30 p. m., on New York & New England, near Franklin, Mass., a passenger train ran into some freight cars standing on the main track, which, together with the engine and several coaches, were badly damaged. An express messenger and 2 passengers were injured.

29th, on Pennsylvania road, near Paoli, Pa., a freight train which had stopped to do some switching was run into by a following freight. The caboose of the first train and the engine and 4 cars of the other were derailed and thrown over on the westbound main track in front of an approaching freight, the engine and 11 cars of which were added to the wreck. A brakeman was badly injured. There was a dense fog at the time.

29th, on Louisville & Nashville, near Warrior, Ala., a passenger train which had been stopped by a disabled freight train ahead was run into by a following freight, badly damaging the rear sleeper. Engineer and 3 passengers injured, the former by jumping.

30th, on Central of Georgia, near Shellman, Ga., a freight train broke in two, and the detached portions collided, damaging several cars and the caboose. Conductor and several passengers in the caboose were injured.

31st, on Western & Atlantic, near Atlanta, Ga., a freight train ran over a misplaced switch and into the rear of another freight, damaging both locomotives and several cars. An engineer and fireman were seriously injured.

31st, at Dearborn and 31st streets, Chicago, a Chicago & Eastern Illinois passenger train, which had stopped to take on passengers, was run into at the rear by a Chicago & Erie freight train, badly damaging several coaches, killing 1 passenger and injuring 3 passengers and 3 trainmen. The cars took fire from the overturned stoves, but the flames were soon extinguished. The passenger train was behind time.

And 28 others on 19 roads, involving 3 passenger and 45 freight trains.

BUTTING.

1st, 10.30 p. m., on Baltimore & Ohio, at Knoxville Siding, Md., butting collision between westbound passengers train No. 9 and eastbound freight train 46, killing an engineer and a fireman and injuring the other fireman. Train 46 had orders to run east on the north track after No. 9 had passed, but started from Weverton after the passage of No. 7 and on the time of No. 9, meeting it before it had gone a mile.

3d, on Central of Georgia, near Americus, Ga., butting collision between two freight trains, wrecking both engines and 10 cars. Two trainmen injured. An operator's mistake was the cause.

6th, on Columbus, Hocking Valley & Toledo, at Fostoria, O., butting collision between a passenger train and a freight train, badly damaging the engine and several cars in each train. Conductor and several passengers slightly injured.

6th, on Chicago, Rock Island & Pacific, near Sabetha, Kan., butting collision between freight trains, throwing a caboose down an embankment and injuring 12 passengers. One of the engineers was killed by jumping, and 3 other trainmen were severely injured.

6th, on Chicago, Rock Island & Pacific, near Berne, Kan., collision between two freight trains, making a pretty bad wreck. An engineer was killed and 5 trainmen were injured.

10th, on Baltimore & Ohio, near North Baltimore, O., butting collision between two freight trains during a dense fog, doing considerable damage. Fireman killed and 2 other trainmen injured.

13th, on Housatonic road, near South Norwalk, Conn., butting collision between a passenger train and a construction train which was running on the passenger train's time, damaging both engines and a mail car. One trainman injured.

19th, on Pennsylvania, at Georgetown, Pa., butting collision between two freight trains, piling up the engines and 20 cars in a bad wreck. An engineer was caught in the wreck and badly injured. A heavy snow-storm prevailed at the time.

19th, on Richmond & Danville, near Bridgewater, N. C., butting collision between two passenger trains, due to an operator's mistake, badly damaging both engines and injuring several passengers.

23d, on Central of Georgia, at Clark's Cave, Ga., a passenger train moving at speed ran over a misplaced switch and into head of a freight standing on a siding, badly damaging both engines and several cars of the passenger train, and throwing a number of box cars over an embankment. Four trainmen and 2 passengers injured.

26th, evening, on Union Pacific, at Florence, Kan., butting collision between regular eastbound passenger train and a special consisting of 2 locomotives, 7 coaches and 24 freight cars, carrying soldiers, in which the forward portions of both trains were wrecked, 3 soldiers killed and 10 soldiers, 3 other passengers and 2 trainmen injured. Many cavalry horses were also either killed or maimed. It is said that the special was running on the other train's time.

30th, about 11 p. m., on Norfolk & Western, near Eggleston, Va., butting collision between 2 freight trains, due to a mistake in orders, badly damaging both engines and several cars. One trainman was killed and 3 other trainmen injured.

And 8 others on 7 roads, involving 1 passenger and 15 freight trains.

CROSSING AND MISCELLANEOUS.

1st, at Newport, Ky., collision between Chesapeake & Ohio and Louisville & Nashville engines, damaging both. Engineer injured.

2d, on West Shore road, at New Durham, N. J., collision between a gravel train and a yard engine at a switch. A dense fog obscured the signals. Both engines and several cars damaged. Six trainmen injured.

3d, on New York, Chicago & St. Louis, at Elyria, O., an engine backed over a misplaced switch and into a westbound passenger train moving at speed, badly damaging both engines and the 2 foremost cars. Two trainmen injured.

4th, on Denver & Rio Grande, at Blanca, Col., several cars of a switching freight train broke loose while ascending a grade and ran back into a caboose standing at the foot of it, doing considerable damage and injuring two passengers in the caboose.

5th, on Lake Shore & Michigan Southern, at Toledo, O., a yard engine collided with some freight cars during a heavy snowstorm, killing two trainmen and badly injuring another.

7th, on St. Johnsbury & Lake Champlain, at North Concord, Vt., a mixed train, standing on a summit, with engine and 11 cars on the east side and 1 passenger and 7 freight cars on the west side, broke apart in two places when it was started to move from the tank to the coal sheds. The conductor, who had just got off the rear car and walked about 200 ft. forward, jumped upon the nearest freight car and applied the brakes; but, after mounting the car, he discovered that he was not holding the rear portion, and he ran to catch it, but on account of deep snow he was unable to do so, and the passenger car, from which all the passengers had just alighted, and 4 freight cars ran back 11 miles to the foot of the grade, where they collided with some loaded freight cars, causing $1,000 damage.

11th, 9:45 a. m., on Third avenue line of Manhattan Elevated road, near 118th street, New York City, a southbound passenger train ran past a danger signal and struck an engine moving in the same direction which was pulling some empty cars from a siding to the main track, pushing the latter engine along some distance and finally knocking it off into the street. No one was injured except the engineer, who was dragged some distance on the sleepers, but did not fall to the street. A brakeman of the switching train set the switch for his train to pull out upon the main track, apparently without regard to the rights of the passenger train, and the engineer of the latter claims that he did not see the distant signal against him until he was within 50 ft. of it. The New York State Railroad Commissioners, after investigation, recommend that the distant signal be placed farther away from the switch.

14th, on Great Northern, at Ground House, Wis., collision between passenger and freight trains, in which an engineer was injured by jumping.

14th, 8 a. m., on Long Island road, at Jamaica, L. I., collision at a crossover track between a slowly moving freight train and a light passenger train moving at considerable speed, badly wrecking both engines and damaging 1 passenger and 1 freight car. One passenger was fatally injured and 7 others less seriously; 1 fireman was also injured.

18th, on Pennsylvania, at Frazer, Pa., collision between two freights, badly damaging both engines and 15 cars. A fireman was injured.

21st, on West Shore road, near Tappan, N. Y., collision between 2 freight trains, killing an engineer.

23d, 6 p. m., on Chicago, Milwaukee & St. Paul, near Chicago, Ill., side collision between an accommodation train and a freight train, due to faulty switching of the latter. A fireman was caught between the engine and tender and badly injured.

25th, night, on the Northern Pacific, near Butte, Mont., a sleeping-car which had been detached from the rear of a passenger train and left standing on the main track some distance from the station, where a switching engine was to be coupled to it for the purpose of taking it to Garrison, was run into at the front end by a heavy freight train, which approached on a descending grade at uncontrollable speed. A passenger on the platform was knocked off, run over and killed, and 5 passengers and 3 trainmen were injured. The passenger car was left standing at this place a longer time than usual. The freight generally started from the yard soon after the arrival of the passenger train.

27th, on New York Central, at Peekskill, N. Y., a work train crossing the main tracks was run into by a freight train, badly wrecking both engines and a number of cars and blocking traffic several hours. The freight ran past a danger signal.

29th, on Manhattan Elevated, at South Ferry station, New York City, an engine approaching to couple onto a northbound passenger train was not controlled, and bumped into the train with such force as to damage the platform of one of the cars. It is said that the brakes on the engine were inoperative.

29th, on Pennsylvania, near Berwyn, Pa., butting collision between two freight trains, one of which was soon afterwards run into by a following freight, wrecking 2 engines and 20 cars and injuring 1 trainman.

30th, on Cincinnati, New Orleans & Texas Pacific, at Lexington, Ky., 3 cars of switching freight train loaded with pig iron broke loose and ran down grade and collided with a passenger train moving at full speed, wrecking them and badly damaging the locomotive. Fireman slightly injured.

31st, near Whitesboro, Tex., collision between Missouri Pacific and Missouri, Kansas & Texas freight trains, making a pretty bad wreck. An engineer was killed.

And 12 others on 8 roads, involving 1 passenger and 14 freight trains.

DERAILMENTS.

DEFECTS OF ROAD.

3d, on Pittsburgh, Fort Wayne & Chicago, near Massillon, O., an eastbound passenger train was derailed by a broken frog while running 40 miles an hour, doing considerable damage.

3d, on Atlantic & Pacific, near Winslow, Ariz., engine of freight train thrown from the track by a broken rail and wrecked, killing the engineer.

4th, on Northern Pacific, at St. Paul, Minn., engine and 6 cars of a switching freight train were thrown from the track by a broken rail, the engine being overturned and badly damaged. The fireman was killed and the engineer severely scalded.

9th, on Atlantic & Pacific, near Walnut Station, Arizona, the forward portion of a passenger train was derailed by a broken rail and ditched, killing the engineer.

12th, on Meriden, Waterbury & Connecticut River, near Westfield, Conn., engine and combination car of a passenger train went through a trestle over Little River, part of which had been washed away by a freshet. One passenger narrowly escaped drowning.

14th, on Atchison, Topeka & Santa Fe, near La Junta, Col., the two rear sleepers of a southbound passenger train were derailed by a broken rail, overturned and badly damaged, injuring seven passengers.

20th, on Central of Georgia, near Thomaston, Ga., 2 cars of a passenger train thrown from the track by a broken rail, injuring the conductor.

23d, on Illinois Central, near Middlebury, Miss., passenger train thrown from the track by a broken rail Conductor injured by jumping.

And 8 others on 7 roads, involving 2 passenger and 6 freight trains.

DEFECTS OF EQUIPMENT.

2d, on Georgia Pacific, near Brookside, Ala., 2 cars of an accommodation train were derailed by a loose wheel under a freight car, disarranging the track. Two passengers injured.

6th, on Newport News & Mississippi Valley, near Midland, Ky., the boiler of a locomotive of a freight train exploded, killing the engineer and fireman and overturning the baggage car. The locomotive was built in 1883, and was thoroughly overhauled and tested in August last.

13th, on Baltimore & Ohio, at Chester, Pa., 9 cars of a freight train were derailed by a car door dropping upon the track.

14th, on Baltimore & Ohio Southwestern, at Hillsboro, O., 3 cars of a construction train were derailed by a broken axle, injuring a brakeman and 2 employés.

23d, on Delaware & Hudson, at Green Island, N. Y., a car of a switching freight train became detached and ran off a siding into a flagman's shanty, demolishing it complete and badly injuring a flagman.

And 10 others on 9 roads, involving 4 passenger and 6 freight trains.

NEGLIGENCE IN OPERATING.

9th, on Cleveland, Cincinnati, Chicago & St. Louis, near North Vernon, Ind., passenger train derailed by a misplaced switch. The forward portion went over an embankment in a bad wreck, badly injuring engineer and fireman.

10th, on Missouri Pacific, near Lone Tree, Mo., 10 cars of a freight train were derailed and thrown over an embankment by a fish-plate which sectionmen had left unfastened.

12th, on Maine Central, near Crawford's, Me., a freight train consisting of 21 cars loaded with grain broke away from the caboose while descending a steep grade and became uncontrollable and was derailed, all but the engine and following car going over a high embankment, making a very bad wreck. The rails were icy. Two trainmen killed.

30th, on Union Pacific, near Echo, Utah, a westbound freight train consisting of 26 cars became uncontrollable in descending a grade and ran at terrific speed for 9 miles, when it was derailed at a curve and piled up in a ditch. Fireman and 2 brakemen injured, one of the latter fatally.

30th, on Kansas City, Wyandotte & Northwestern, near Kansas City, Mo., the forward portion of a freight train was derailed and wrecked at a misplaced switch, seriously injuring engineer and fireman. A stockman in the caboose, who was subject to heart disease died, of fright.

And 3 others on 3 roads, involving 3 freight trains.

UNFORESEEN OBSTRUCTION.

4th, on Vicksburg & Meridian, near Jackson, Miss., an eastbound passenger train ran over a cow and the locomotive and baggage car were derailed and ditched, badly injuring the baggagemaster.

13th, on East Tennessee, Virginia & Georgia, near Bell Station, Miss., a passenger train ran over a steer, and the entire train was derailed and ran clear of the track, the locomotive and several cars being overturned. Engineer, conductor and several passengers injured.

17th, on Illinois Central, near Tchula, Miss., passenger train derailed at a point where track fastenings had been maliciously moved. The entire train was derailed, the baggage and express cars going over an embankment.

20th, on Chesapeake & Ohio, at Winifred, W. Va., a passenger train was derailed by a purposely misplaced switch, and crashed into some freight cars standing on a siding, a number of which, together with the locomotive, were wrecked. Fire broke out and the conbustible portion of the locomotive was destroyed. Engineer and fireman seriously injured.

24th, night, on Cleveland, Cincinnati, Chicago & St. Louis, near North Vernon, Ind., a passenger train was derailed by some stones which had been maliciously piled upon the roadbed, the entire train going into the ditch.

29th, at South Norwalk, Conn., a New York, New Haven & Hartford freight ran into some wreckage thrown over by a derailed Housatonic freight train on an adjoining track, wrecking engine and 15 cars and damaging the freight house platform. Two brakemen were injured.

30th, on Pittsburgh, Cincinnati & St. Louis, near Sheridan, Pa., a freight train was derailed by a mass of earth and rock which had fallen on the track at a tunnel, badly damaging engine and 3 cars. A brakeman was killed and the engineer and fireman were badly scalded.

And 9 others on 8 roads, involving 3 passenger and 6 freight trains.

UNEXPLAINED.

7th, on Richmond & Danville, near Gaffney City, S. C., a freight train derailed on a curved trestle, causing the explosion of the locomotive boiler and making a bad wreck, in which 4 trainmen were killed and 2 injured.

14th, on Louisville, New Orleans & Texas, near Baton Rouge, La., freight train derailed. The locomotive was overturned, seriously injuring engineer and fireman.

14th, on Philadelphia & Reading, near Glenworth, Pa., 6 cars of a stock train were derailed and wrecked, badly injuring a trainman.

15th, on St. Louis & San Francisco, near Richmond, Mo., passenger train derailed on a curve and several cars partially overturned in the ditch, slightly injuring several trainmen and 1 passenger.

16th, on Covington & Macon, near Madison, Ga., passenger train derailed, and one coach thrown over an embankment and wrecked, injuring about 15 passengers.

17th, on Central of Georgia, near Midway, Ala., passenger train derailed, injuring 2 trainmen.

19th, on Rio Grande Railroad, near Brownsville, Tex., a passenger train was derailed just after daylight in the morning by 15 masked train robbers, who locked up the passengers in a freight car and rifled the express and mail cars, securing booty valued at about $30,000. The engineer and fireman were badly injured.

21st, on Queen & Crescent Route, near Chunkey, Miss., 12 cars of a freight train derailed and upset slightly injuring conductor.

26th, on Birmingham Mineral, near Milldale, Ala., engine and five cars of freight train derailed and thrown down a 15-ft. embankment. Engineer seriously and fireman slightly injured.

30th, on Illinois Central, at Bradford, Tenn., engine of freight train derailed and overturned, badly injuring the engineer.

And 28 others on 21 roads, involving 3 passenger and 25 freight trains.

OTHER ACCIDENTS.

13th, on Philadelphia & Reading, near Ashland, Pa., a locomotive of a freight train standing on a siding exploded its boiler, killing 3 trainmen and badly injuring another.

15th, on Queen & Crescent Route, near Vicksburg, Miss., the engine of a standing passenger train exploded its boiler, wrecking it completely. Engineer and fireman killed, and a switchman standing near by was severely scalded.

17th, on Union Pacific, near Denver, Colo., a freight car in an accommodation train took fire, presumably from locomotive sparks, and, together with a following passenger car, was burned up. A brakeman, who passed over the burning car in order to communicate with the engineer, was so badly burned that he died several hours afterward.

19th, on Northern Pacific, near Timberline, Mont., the front of boiler of engine of switching freight train blew out, wrecking a freight car. Engineer and fireman severely scalded.

And 8 others on 8 roads, involving 7 passenger and 1 freight train.

A summary will be found in another column.

Third Annual Convention of Railroad Commissioners.

The first session of the third annual convention of State and Interstate Railroad Commissioners, accounting officers and others was held in Washington on Tuesday of this week, with an attendance of about 30. Judge Cooley was elected Chairman of the convention: Commissioner George G. Crocker, of Massachusetts, Vice-President; E. A. Moseley, Secretary, and M. S. Decker, Assistant Secretary.

Judge Cooley, as the Chairman of the last convention, read his annual address. In opening he said: "Perhaps no better use can be made of the opening hour of our meeting than to devote it to an endeavor to ascertain precisely what is meant by the 'railroad problem.' . . . The railroad problem is not to be found in the legislation authorizing the building of railroads. It is not to be found in the condition in which the roads may be put by their projectors or managers, nor the manner in which they are equipped for the purpose of operation; neither in the relations between the corporations and their employés. It is not to be found, exclusively, at least, in the diversities which exist between the legislation of the several states when compared with each other or with that of the federal government; neither in the fact that railroad rates are supposed by the public to be in a great many cases much too high, or that there is unlawful discrimination in the transportation of freight and passengers, and that many persons are carried free who are not entitled to it by law. . . .

"This is the 'railroad problem.' The main source of difficulty lies in the power as it exists now to make and unmake the rates. So long as 500 bodies of men in the country are at liberty to make rate sheets at pleasure, and to unmake or cut and recut them in every direction at their own unlimited discretion, or want of discretion,

and with little restraint on the part of the law except as it imposes a few days' delay in putting changes in force, the problem will remain to trouble us; the mere existence of the power making losses, disorder and confusion constantly imminent. The authority to reduce rates, when they are found to be excessive, is but a slight corrective, and reaches the evils only on the public side; and I need hardly remind you that the power on the part of the public authorities to compel the railroads to do what is just to each other in respect to observing rates which they have once made is so very slight that it may really be regarded as too insignificant to be spoken of as possessing substantial value." Judge Cooley did not discuss the solution of the "railroad problem."

The report of the Committee on Legislation gave rise to a brief discussion in regard to securing uniformity in the adoption of automatic couplers and power brakes. It was stated that the Interstate Commission had brought these matters before Congress. Mr. Rogers, of New York, thought that a federal law should be en acted. The further consideration of this subject was postponed until Wednesday.

A paper on discriminations resulting from the use of private cars was read by Commissioner Schoonmaker. The conclusion was reached that if the entire prohibition of the use of private cars of shippers was not practicable, a feasible plan would seem to be that the payments in no case should exceed what the expense would be to the carrier if it owned the car.

The Committee on Reasonable Rates, W. B. Fleming of Kentucky, chairman, made a long and exhaustive report, and on Wednesday morning, after a general discussion, the resolutions offered by the Committee were adopted, as follows:

That it is competent for the Congress of the United States and for the legislatures of the various states to regulate, within their respective spheres, the rates of freight and passenger traffic and travel, subject only to those legal and constitutional limitations which, under our system of government, circumscribe the exercise of all legislative and administrative acts.

That it is within the power of Congress and the state legislatures to delegate the power of reasonable regulation of rates to boards of commissioners, and to make their findings upon questions of fact, after fair legal opportunity to be heard, as conclusive and binding upon the courts as the findings and acts of other administrative officers.

That uniformity is desirable in congressional and state legislation on the subject of rates, to the end that public regulation of rates may be practically reached by the active co-operation between state and interstate commissions.

The following resolutions were also adopted:

That a committee of five be appointed by the Chair to urge upon Congress the imperative need for action by that body calculated to hasten and insure the equipment of freight cars throughout the country with uniform automatic couplers, and with train brakes, and the equipment of locomotives with driving-wheel brakes, and present and urge the passage of a bill therefor. That the committee, before presenting the bill to the appropriate Congressional committees, be requested, after public notice, to give a hearing to accredited representatives of such organizations of railroad officials or employés as may desire to be heard.

The conference adjourned to meet in Washington on the second Wednesday in April of next year.

Alabama Railroad Commissioners' Report.

The Railroad Commissioners of Alabama, Henry R. Shorter, Levi W. Lawler and W. C. Tunstall, have issued the tenth annual report of the board, with statistics to June 30 last. The new road built during the year was 189 miles, and 550 miles is now under construction or has been finished since. Five roads have failed to send in their annual report, and complete statistics are, therefore, hard to get; but the commissioners estimate the total mileage of road in the state to be 3,166. The increase in the valuation of railroad property in the state during the past 10 years has been 30 million dollars, about 200 per cent. Various complaints of dangerous bridges and the action of the board thereon are detailed. The question of discrimination by railroads in their treatment of competing steamboat lines was decided by the board, but was appealed to the Interstate Commerce Commission. The latter body, however, sustained the state decision.

The law of Alabama requires station agents where passenger trains are late to post a bulletin each hour for four hours telling how late the train is. The commissioners have tried to enforce this, but the roads do not obey so well as they ought to. The commissioners are also troubled because the railroads delay their passenger trains to make connections with through trains from other states and thereby greatly inconvenience local travel. If through travel is so very important, separate trains should, they think, be run to accommodate local passengers. The board urges the roads to abolish fires in passenger cars. The National Convention of Railroad Commissioners is reported at length.

In concluding, the commissioners branch out into the general subject of commercial prosperity and express the hope that the volume of currency will be so augmented as to enhance the prosperity of the cotton planters of Alabama. The statistics given in the reports of the companies are not summarized.

From Chicago to Liverpool by Deep Water.

Why should the lake cities, with their wealth and resources, not import for themselves and transact their own business? The ocean is the prerogative of no state of the Union.

The above quotation from "an advocate of water-way enlargement" is the theme of an able paper read by Mr. E. L. Corthell before the Canadian Society of Civil Engineers, Feb. 12, under the title of "An Enlarged Water Way between the Great Lakes and the Atlantic Seaboard." We shall attempt to give only a synopsis of the paper, which is long and carefully studied.

Mr. Corthell defines an enlarged water-way as one that will dispatch vessels of 5,000 tons displacement economically and with speed, and the minimum depth is fixed at 20 ft., no less depth being considered in his discussion. It is shown that this question has occupied the attention of able men since the early part of this century, and Mr. Corthell gives an interesting review of the various efforts which have been made, both in the United States and Canada, to bring it to a successful issue.

The conditions bearing on the scheme at present are treated in the broadest manner, and a careful study is made of the development and condition of the commerce of the Great Lakes and that tributary to them. The inception and development of existing canals, the growth of lake cities, the constant reduction in carrying charges and the relation of railroads to the general problem are all considered. The following tabulated statement will show how the capacity of existing canals has been increased:

	Locks.						Total expenditure.
	Original.			Present.			
	Length.	Depth.	Width.	Length.	Depth.	Width.	
Sault Ste. Marie	270	12	70	800	21	100*	$7,238,000
St. Clair Channel	....	13	....	....	20	....	700,000
Welland Canal	110	8	22	270	14	45	23,787,000
St. Lawrence system	....	8	....	270	14	45*	54,000,000
Erie and Oswego	110	7	18	110	7	18	133,000,000

* Not yet completed.

The volume of the lake tonnage and the rates are given in some detail. The cost of carrying freight in 1887 for an average distance of 800 miles on the lake lines was 2.3 mills, and in 1889, 1.5 mills. In 1889 the lake lines carried a mile-tonnage equal to 22.6 per cent. of the total freight service rendered by all the railroads of the United States. The railroad rate per ton-mile for that year was 9.22 mills. Much of the heavy freight has been carried by water at less than 1½ mills per ton-mile. Anthracite coal is carried from Buffalo to Duluth and Superior, a distance of 1,000 miles, for 30 cents per ton, or 0.3 mills per ton-mile. Figures are given showing that the yearly tonnage through the Detroit River is 10,000,000 more than the entrances and clearances of all the seaports of the United States, and 3,000,000 tons more than all the foreign and coastwise shipping of London and Liverpool.

The problem of putting the Great Lakes with this immense commerce into direct communication with the Atlantic by ocean-going craft is that which Mr. Corthell has set himself to study in this paper. He gives a brief review of the improvements already made and under way, which will soon give a 20-ft. water-way from the lower lakes to Lake Superior and a 14-ft. water-way from Montreal. He then takes up the various projects for ship routes between the Atlantic Ocean and the Great Lakes.

The Hurontario project is for a canal or ship-railroad from Georgian Bay to Toronto, involving also improvements in the St. Lawrence River and its canal system.

The Ottawa Ship Canal is by French River, from Lake Huron to Lake Nippissingue; thence by canal to Trout Lake; thence by Matawan and Ottawa Rivers and Lachine Canal to Montreal.

Another route is by the Welland Canal and St. Lawrence.

The Michigan Peninsula route contemplates a ship-railroad from Benton Harbor, on Lake Michigan, to Monroe, on Lake Erie.

A comparison of the principal features of these routes is given in a number of tables, which may be summarized as follows:

Chicago to Liverpool.

Route.	Length, miles.	Time, in hours.	Cost per ton.	No. days route is open.
1. Hurontario Ship R. R. Lakes and St. Lawrence River	4,226	313.47	$3.48	225
2. Lakes and Ottawn Navigation	4,203.76	326.50	4.59	205
3. Lakes, Welland Canal and St. Lawrence River	4,488	346.91	3.97	225
4. Mich. Peninsula Ship R. R. Lakes, Welland Canal, etc	4,067.25	327.37	3.66	229
5. Mich. Pen. Ship R. R., Lakes Niag. Falls Ship R. R. and St. Lawrence	4,066	311.00	3.53	234
6. Mich. Pen Ship R. R., Niag Falls Ship Canal and St. Lawrence	4,066	318.72	3.70	229
7. All rail to Montreal	4,062	328.33	6.25	234
8. All rail to New York	4,353	337.33	6.74	365

Mr. Corthell estimates that the Hurontario Ship Railroad can be built in three years, at a cost of $15,459,318.00, fully equipped. It would be 66 miles long, with maximum grades of 33 ft. per mile, and three deflection tables to change direction. He thinks the St. Lawrence canals could be enlarged, to take vessels drawing 20 ft., in five years.

THE SCRAP HEAP.

Notes.

The Northern Pacific will on March 29 adopt the standard code of train rules.

The Southern Pacific, after long negotiations with employés in the train service, has settled a number of grievances. These are the same men who made similar complaints a few months ago.

Dennis McCloskey, a saloonkeeper of Gloucester, N. J., has been sentenced to five years in the state's prison and $500 fine for repeated attempts to wreck passenger trains on the Gloucester branch of the Philadelphia & Reading.

The Boston & Albany is to erect two interlocking plants at Springfield, east and west, respectively, of the new union station. The latter will be a large one, covering the junction of the New York, New Haven & Hartford and the Connecticut River roads.

An amendment to the Interstate Commerce law has been passed and approved which increases the powers of the commission by giving it authority to compel the attendance of witnesses and the production of such documentary evidence as may be required from any part of the United States at any designated place of hearing. The testimony of any witness may be taken by deposition at any time. Depositions may be taken before any judge of any court in the United States or any commissioner of a circuit, chancellor, justice, or judge of a supreme or superior court, mayor or chief magistrate of a city, judge of a county court or court of common pleas of any of the counties of the United States, or any notary public, not counsel or attorney or otherwise interested in the case. Persons may be compelled to appear and depose and produce documentary evidence in the same manner as witnesses may be compelled to appear before the commission. Provision is made for taking depositions in foreign countries.

Bessemer Production in 1890.

The production of Bessemer ingots, including Clapp-Griffiths and Robert-Bessemer, was 3,681,727 gross tons, or 4,123,535 net tons, showing a gain over last year's make of 25 per cent. This is our largest production in any year, exceeding that of 1887, when we built 12,872 miles of railroad, by 755,694 tons. During the same time our production of rails was 1,797,490 tons, a gain of 22 per cent. on last year's make, which gives us the largest make of any year except 1887, when the production exceeded that of this year by 304,414 tons.

By half years the makes have been as follows in gross tons:

	First Half '90.	Second Half '90.	Total.
Ingots	1,822,534	1,859,193	3,681,727
Rails	922,017	875,473	1,797,490

Nearly 49 per cent. of the total Bessemer production went into rails. About 61 per cent. of the ingots and over 69 per cent. of the rails were made in Pennsylvania, while for Illinois the percentages are 20.5 and 29 per cent.

The Illinois Steel Company.

At the second annual meeting of this company the directors and officers of last year were re-elected. The officers are: President, Jay C. Morse; First Vice-President, W. R. Stirling; Second Vice-President, H. S. Smith; Treasurer, J. C. Stirling; Secretary, W. B. Perkins. The president's report sets forth that the company received, during 1890, 3,612,660 tons of raw material, and shipped 928,769 tons of finished products, or rather less than one-fourth of the tonnage received. All of the finished products and about 80 per cent. of the raw material was transported in cars: 209,421 car loads, averaging 18.22 tons per car. Of the expenditures—$8,615,003.48 - $1,751,587.10 was paid for stores and supplies and $6,863,416.38 for wages and salaries; 9,648 men on an average were employed during the year. The principal products for the year were: Pig iron, 720,000 tons; spiegel, 36,000 tons; ingots, 733,000 tons; rails, 509,000 tons; billets, 80,000 tons; rods, 54,500 tons; beams, angles, merchant steel, and iron, etc., 70,000 tons. On the completion of the furnace stacks now building the company will own 19.

The stockholders have voted to increase the capital stock from $25,000,000 to $50,000,000, as it is thought desirable to increase the capacity of the works, not only with reference to the growing demand of the country for rails, beams, etc., but to put in a plant to roll plates and angles for ship building, the Chicago shipyard at present getting its material from Cleveland.

The Intercontinental Railway.

The Intercontinental Railway Commission has arranged the preliminaries for the survey of the proposed North and South American Railroad. William F. Shunk is selected as organizing engineer, and will have general charge of the surveying work. Other civil engineers will be selected to assist him, and the co-operation of local engineers in each of the countries through which the proposed road is to pass is promised. There will be three surveying parties, including the military party already assigned to Central American States. The other two parties will be under the immediate direction of Mr. Shunk, and will work respectively north and south from a central point in Colombia.

Storms and Floods.

The storm of Feb. 25 was the cause of great delay to traffic in the East and in the far West. The New York Central tracks were so flooded between Schodack and Stuyvesant that through trains were sent to Albany from Hudson via Chatham over the Boston & Albany road. In the Mohawk Valley the floods were even more troublesome by reason of ice gorges forming at Big Nose and Tribes Hill. For some hours both the West Shore and the New York Central were submerged between Fort Plain and St. Johnsville. The falling temperature checked the flood, but when the water receded ice was left piled to a height of 20 feet in places on the tracks. The Susquehanna was high, of course, this being its fifth effort this season. Reports from the far West indicate serious damage to all kinds of property. Among the railroads the Southern Pacific seems to have been the heaviest sufferer. At Yuma, Ariz., 22 miles of track was washed away, and bridges were lost at Colton and Barstow. The Santa Fe was temporarily embarrassed at San Bernardino and Colton by the loss of 10,000 ft. of track and the approaches to two bridges. In Colorado the heaviest storm of the season occurred, the fall of snow being 7 ft. deep on a level. Tracks were buried to a depth of 50 ft. on the Denver & Rio Grande, and many heavy slides were encountered on the Rock Island and Burlington roads.

RAILROAD GAZETTE

Published Every Friday,
At 73 Broadway, New York.

EDITORIAL ANNOUNCEMENTS.

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting, and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

Every one remembers Disraeli's *mot* about Gladstone—that he was "intoxicated by the exuberance of his own verbosity." In the matter of the Brooklyn Bridge railroad *Engineering News* seems to be afflicted in much the same way. It has given many pages to proving by words and diagrams that no plan of operating the bridge railroad could possibly succeed except the one proposed by one of its editors and, at least partly, covered by patents taken out by him. The effect of all this outside of the office of that journal can only be surmised. Inside that office there has come about a queer mental condition characterized by unwillingness to admit that any outsider has a right to hold, or, at least, to express, any opinion on the bridge railroad. "We have demonstrated so and so; therefore we are surprised that any one should think otherwise" is about the tone adopted. In the last issue of that journal is an editorial, in fairly good imitation of the style used by the *Evening Post* in its familiar talks to "Judas" and "Ananias," in which the writer again brings out his famous "collision every 90 seconds." In reply we merely urge him to go back two or three weeks in the discussion and read "Dot's" diagram and schedule as they were intended to be read, and as every one else has read them, that is, starting the "B" train first, from the inside of the incoming platform. So long as he persists in starting the "A" train first he will produce that collision; but in practice, the "B" trains will lead, and therefore our contemporary need not lie awake worrying about the collisions which are happening every minute and a half.

In another column will be found an engraving of a radial-stay wagon top boiler, as built by the St. Paul road for its class "B" locomotives. The increasing use of this type of boiler on American railroads is noticeable as one of the interesting departures from common practice. Recently these boilers have been built for a number of prominent roads that have not previously tried them. They are in use largely on the Denver & Rio Grande and the Richmond & Danville, and the New York, Lake Erie & Western has a considerable number on some 10-wheelers built by the Baldwin Works. Owing to the novelty of the construction, we have taken some pains to determine its origin. So far as we can learn, the first boiler of this type was built for the Denver & Rio Grande, in its own shops, for an engine which was being repaired. The design was furnished by Mr. William L. Austin, of Burnham, Parry, Williams & Co., then chief draftsman of the Baldwin Locomotive Works. It seems that at that time Mr. Sample, Superintendent of Motive Power of the Denver & Rio Grande, wanted a radial-stay boiler, while Mr. Ricker, the General Superintendent, insisted on having a wagon top. To meet the demands of both and to satisfy all parties, Mr. Austin devised the radial-stay wagon top, which was quickly seen to possess advantages which were not found either in the crown-bar wagon top or in the plain radial-stay boiler. It permitted the dome to be placed on the wagon top without compelling the use of crown bars. The steam space was increased and the throttle was placed higher above the water line than could be done with any form of radial-stay boiler previous to that time. The nearest approach to it, so far as we can learn, is found in the boilers used on the Chicago & Grand Trunk, which have radial stays at the back part of the firebox and crown bars at the front, under the dome, the dome being placed over the firebox.

One of the 1,400 bills left unacted upon at the adjournment of Congress on Wednesday is House Bill No. 10,172, reported favorably to the House by the Committee on Commerce. This bill reads that nothing in the Interstate Commerce Act shall be construed to prevent any common carrier giving reduced rates of transportation and a permit to carry excess baggage to commercial travelers. This was accompanied by a committee report that there are 180,000 regular commercial travelers in the United States who spend two-thirds of their time "on the road"; that the system of selling goods by sample is of great financial, commercial and economic benefit to every man, woman and child, and that it is the duty of the government to encourage the internal commerce of the country by allowing concessions to drummers. It is often vaguely claimed that drummers' patronage is a very important support to the passenger traffic of various roads or divisions, but no statistics have yet been collected showing just what proportion they bear to the other travelers, and without some such knowledge we are in the dark about the exact value of commercial travel to each road, to particular trains and the like. Concessions as to extra baggage are often made in order to secure the drummers' freight shipments; and no doubt many roads to-day ought to charge more instead of less for the passenger service performed for these men. One of the things asked for by the drummers is a week-end ticket, with a special rate for drummers who wish to go home for Sunday. But this and all their demands will have to be settled on broad general principles applicable to all travelers, if settled on any principle at all. The Interstate Commerce Commission objects to one-way party tickets largely on the ground that they would feed the scalpers: with a drummer's ticket this argument would be twice as strong, and the influence of the Commission would be against such a ticket. Practically, however, there is little use of discussing the technical points of this question, for when we get down to the actual economic question, the railroads can afford to carry all travelers at as low rates as they carry drummers, and they probably would do so. To make a discount on a fare because of the influence of the bargain on freight traffic is in the nature of a prostitution of the passenger department. This department already bears enough burdens that belong to the freight department.

From a St. Paul dispatch we learn that theatrical managers and baseball managers will combine to press upon the roads their demands for more liberal one-way party rates. Both these classes and the drummers—not only the leaders but the rank and file—are well skilled in persuasive arts, and there is throughout the country a feeling that special companies or special classes are "entitled" to privileges in fares and baggage denied to the single traveler: so we may expect these claims to exhibit great vitality, whatever their merits or demerits. Commercial travelers cannot get much benefit from the party ticket, and so their argument is based upon the importance of their patronage during the year as a whole; but the other classes present a more distinct issue. The Interstate Commerce Commission's appeal to the United States Supreme Court to support the Commission's decision that one-way party rates are unjust or illegal is still undecided, and the roads will of course act cautiously while matters remain in this condition; but as long as we have two or three railroads to do the business of one—as is the case in the Northwest—no one need lie awake nights to mourn over the hardships of the theatrical and baseball people. They will "get there" without much trouble. These people, as well as the drummers, will find difficulty in showing any grounds in law or common sense for claiming more favorable concessions than are granted to butchers, bakers or candle-stick makers under the same circumstances; but as long as there are a great many roads that would be benefited if their traffic officers were stirred up by an earthquake—either physical or dramatic—to more effectively stimulate local passenger traffic generally, it will perhaps not be an unmixed evil for the theatrical people to keep up their demands.

We give elsewhere an abstract of the report of the Pennsylvania Railroad Company. We refrain from comment, because the figures are so arranged as to tell very little. It is impossible to know from the report how much of the earnings of the whole system were from freight and how much from passengers, or how much of the expense was due to transportation charges and how much to maintenance. We have no train-mile figures and can tell nothing about train loads or train economy. We are given some figures of cost per ton-mile and per passenger-mile, made up on a system which, though sanctioned by the Interstate Commerce Commission, is worse than arbitrary. The report would indicate that the average cost of transporting a passenger a mile, on lines east of Pittsburgh, had fallen from 1.529 cents in 1889 to 1.504 cents in 1890. We are confident that the greater part of this reduction is due to the fact that a larger proportion of general expenses is assigned to freight traffic in 1890 than was the case in 1889; but the figures which ought to test this surmise are kept out of reach. Perhaps the General Manager's report will give them. It is fortunate for the stockholders of the Pennsylvania Railroad that the directors know more about managing the property than about writing annual reports; unless, indeed, it be true that they know how to write a report and prefer not to do it as well as they know how. In either event the stockholders must rely on the integrity of the management rather than on what the report really tells them.

The principal points brought out in the coroner's investigation of the Fourth Avenue tunnel collision are printed in another column. The most noteworthy incident is the apparently narrow escape from a second collision within three hours after the first, and at the same station. The fog was very dense that morning, and it would appear that the engineers who constantly work under the trying conditions of this dark and smoky tunnel are subject, like runners on less difficult lines, to that mental infirmity which leads them to depend for safety on other than the prescribed means. It is true that, in a clear day, when the preceding train has been gone some time, and trains moving in the opposite direction are met at favorable places, and engines in the adjoining tunnel do not throw steam or smoke (through the lateral openings) in front of the signals, an engineer can run the whole length of the tunnel at high speed with perfect safety. This is done every day, perhaps by a large majority of the trains; and it may be that the force of habit has the same kind of effect on these men as on the great majority of runners generally. That the general discipline of the engineers is not bad is indicated by the fact that only four have missed signals in 15 months, during which time probably 160,000 trains have run through the tunnel. It appears that special watchmen were stationed at the signals after the accident, but if this was done on account of the fog (or the obscurity of the signals from any cause) it is somewhat strange that the men were not provided with torpedoes.

As is well known, the English roads handling the enormous London traffic are compelled, during the incredible fogs characteristic of that city, to not only station men at all distant signals but to let them use up thousands of torpedoes. The New York tunnel is not liable to very bad or very frequent fogs, but the least the managers can do is to fully follow the English practice in this particular, if the record of Feb. 20 is an indication of the character of the engineers generally. At the same time it seems illogical to lay out a scheme of this kind, when it is admitted that smoke and steam every day produce practically the same kind of a difficulty as the fog; and for this reason a reliable audible signal, to be used constantly, affords the best means (that has stood the test of a practical trial) of meeting the demand arising in consequence of this fatal collision. And it would certainly look unscientific, if not illogical, to keep a man at each signal post night and day unless, indeed, we assume that mechanical means are wholly unavailable. As this assumption is not necessary, an automatic audible attachment to the usual signal is the most promising remedy. The place for an audible signal is at the caution and not at the home signal (although one at the home signal would undoubtedly have prevented this collision); and one objection to an automatic device like the Palmer is that if placed at the caution signal it will use up a great many torpedoes when the weather is clear and an audible signal is unnecessary, thus entailing a needless expense. But with runners educated to a proper degree of discretion the greater part of this unnecessary use can be avoided. Nine times out of ten a runner who finds a distant signal at caution knew beforehand, or might easily have known, about where the preceding train was, and could have "loafed" longer and thus avoided the stop or the slackening; moreover, it is much pleasanter to passengers to ride slowly without stops than for the runner to rush forward at the top of his speed from each

home signal only to pull up again suddenly at the next block. Every day dozens of engineers hurry into the Fourth Avenue tunnel only to be stopped by a preceding train, when they might just as well have stopped out in daylight, and yet have reached destination at practically the same time. In some cases the yard work is facilitated by making every train clear out as far as possible, as quickly as possible; but this is not an irremediable obstacle.

Car Lighting.

In this issue we give a paper, by Mr. George Gibbs, on Car Lighting. Although it is long, we give it nearly in full, because it is the most comprehensive and intelligent study of the subject that has been made public for a good while. Of course, it is general. It was not within the scope of the occasion to present many of the figures which underly the conclusions expressed. More specific information concerning the St. Paul experiment with electric lighting can be found in the account of the "light and heat tender" published in the *Railroad Gazette* last summer.

This experiment is Mr. Gibbs' most important original contribution to the subject. It is one of the most complete and extensive installations ever made for electric train lighting, and the practical results are correspondingly instructive. Therefore the table of comparative data which appears in the paper is of especial value. Mr. Gibbs concludes that the lighting systems that are now to be considered, and from which railroads will choose, are mineral oil, the Pintsch, the Frost and electricity. There can hardly be two opinions as to this conclusion. We take from his table the following figures for these four systems:

	Candle power per car.	Running cost per car per hour, cents.	Cost per candle power per hour, cents.	Cost of equipment per candle power.
Mineral oil.....	168	2.51	.015	$0.67
Pintsch.....	170	2.60	.015	3.24
Frost.....	180	4.60	.026	2.98
Electricity.....	160	9.83	.061	2.47

The electric system here given is the one now in use on the St. Paul with the tender car. It will be seen at a glance that the cost per candle power is so much greater than that of either of the other systems as to rule electricity out of consideration unless there are special reasons for using it. This, we suppose, is the conclusion that had been reached some time ago by those familiar with the subject. Three years ago experimenters on the Würtemberg railroads showed a cost of from .05 to .07 cents per candle power per hour for electric lighting. This was direct lighting by dynamo. An estimate made in 1887 of the cost of lighting by storage batteries on the Boston & Albany placed it at about 0.064 cent per candle power. Another storage battery experiment is said to have cost .13 cent. Other figures more or less definite have been published from time to time, but they have generally been manufacturers' estimates of what could be done, and much too low, or figures from the performance of crude installations, and much too high. Mr. Gibbs' figures are from the actual work of a carefully designed plant, for a considerable period, and are doubtless fair and accurate. It is rather remarkable that they agree so nearly with earlier experiments. At any rate, they settle the status of electric lighting for the present in all cases when economy must control. But no one can tell how soon great improvements in storage batteries will cut down the cost of electric lighting by an accumulator system to a point far below any that has yet been touched.

For the present, then, the question is between oil, the Pintsch system and the Frost; and Mr. Gibbs' conclusion is in the main very judicious, viz., that oil lighting is so safe and cheap, and can be made so brilliant, and so agreeably distributed, that any other system should be very carefully examined before it is adopted. Any one who has traveled much knows that cars *can* be well lighted by oil lamps. Some of the best lighted cars in the country are so lit; but, on the other hand, everybody also knows that cars seldom are well lighted by oil. It is very rare to find a car in which one can read for two hours in the evening with comfort and without fear that he is injuring his eyes. Moreover, any one who travels much knows that oil lamps are very apt to smell badly and to heat and vitiate the air to an unwarranted degree. These are not fundamental defects of this mode of lighting, but they are very common defects. But it does not always follow that a Pintsch car is well lighted. We are very familiar with cars lighted by the Pintsch system that are often darker than the average oil-lighted car and seldom light enough to read in. Such cases have nothing to do with Mr. Gibbs' figures, which are from experiments, standardized and made strictly comparable; but they are mentioned as a hint to those who, like Mr. Gibbs, "hope that the popular outcry will not be directed towards the lighting problem." A word to the wise is sufficient. We sincerely hope that the lawmakers will keep their hands off from car-lighting; but immunity from legislation cannot be secured unless the public is reasonably satisfied.

In the matter of the safety of oil lighting we probably agree entirely with Mr. Gibbs. That is, we admit all that he says of the extreme improbability of a fire originating from the explosion of a lamp, or from the flame of a lamp broken or upset in a wreck. But he admits, what we have long held, that in case of a wreck there is an added danger in the saturation of woodwork and upholstery with kerosene. The only difference is, that Mr. Gibbs thinks that fire has no place in a wreck, and therefore it is immaterial whether or not the wreckage is more or less combustible; while we think that fire will be present in wrecks for some time yet, set either by heaters or by coals from the firebox, or from ranges in dining cars. For example, the recent accident in the tunnel in New York City is probably a case in point. There is no evidence that the lamps were lighted, and there is evidence that the wreck was set on fire by heaters; but the fire blazed up so quickly as to make it extremely probable that it was fed by oil from the lamps. While this element of danger in oil lighting is not great, still it must be considered.

Many will be surprised to see that the running cost per candle-power hour of the Pintsch system is no greater than with oil, and that the running cost of the Frost system is about 73 per cent. greater. We have much confidence in Mr. Gibbs' investigation, and therefore do not question his figures; but careful, independent experiments in the laboratory of one of the great roads indicated that the operating cost of the Frost light would be about 50 per cent. greater than that of oil, while the company has always claimed that it is less. Probably we shall hear more on this subject now that it has been brought forward so conspicuously. We have long supposed that trains could be lighted as cheaply by the Pintsch gas as by oil, and in fact Mr. Chanute came to this conclusion several years ago, in an investigation which he made for the Erie when he was chief engineer of that road. The Frost system has, however, considerable advantage in first cost of equipment.

Reckless Trainmen.

In the issue of Feb. 13 we published a letter giving the experience of a general manager with trainmen who rely upon diplomacy rather than an honest presentation of facts to exculpate them when they are guilty of misconduct; who have sometimes succeeded in this policy, and who therefore grow more and more reckless. A similar letter was printed Feb. 20, and both deserve a reading. Such a serious subject ought to be discussed openly and frankly, and it is to be regretted that the writers of these communications do not allow their names to be used; but we nevertheless publish the letters, because the points made in them have been corroborated by statements made to us by other men well qualified to speak on the subject. The strong yet conservative language used by the managing officers of large roads in giving us their views on the subject in hand warrants the reader in treating the signature to the letter of Feb. 13 as conveying the full significance of the words, and not as a mere pseudonym.

The question presented is essentially one of the moral character of employés. Managers have difficulties enough with train and station men who do not sufficiently understand their duties. But the present complaint is not about these; it is about men who know how to do their work, but do not use that knowledge; who have the ability to do well, but recklessly neglect to do as well as they know how. Moral character is necessary in a freight brakeman just as truly as in a passenger conductor or a superintendent. The difficult question presented by our correspondent is occasionally answered by a railroad manager with the proposition that military methods—in other words, force—shall be used. The lessons of military experience do not, however, justify this idea. Work done by military forces would doubtless be found, on comparison of amount and quality, to cost more than has to be paid for railroad work of the very highest efficiency. The most familiar illustration of the use in railroad work of force instead of any other influence is that of employing detectives to report how men are behaving, instead of asking the men themselves. Theoretically, this is taking measures to compel men to be faithful; but after all the main practical result is the influence the system has on men who are not detected; it really is persuasion rather than force that is used.

The question is, how to make men do their best willingly; and we have nothing to fall back upon but the old motives—fear of punishment and hope of reward. The first has been used more than the second. As the condition of things is still unsatisfactory, perhaps the other had better be given more careful trial. If we may judge by surface indications, no kind of punishment except discharge (or suspension, which is simply a mild dose of the same medicine) can be administered with any success. The Pennsylvania Company has, to please its men, just abolished fines, which, so far as equity and justice go, are generally much better than suspension.

The numerous cases during the past year in which managers have acceeded to the demands of their employés have not all been the result of weak-kneed fear on the part of the managers, but, rather, a natural acknowledgment that men must be persuaded and not crowded, and that where persuasion fails time must be taken to get and present facts for further persuasion. There is no way for railroads to punish unfaithful employés any better than they can now punish them. The law has thus far failed to either punish the guilty or quicken the cautiousness of their fellows. Handing the railroads over to the government and ruling the employés directly by the iron hand of law would be no improvement, judging by European roads, and such a method of dealing with operatives would not be tolerated in this country, anyway. Railroads cannot combine to assist each other in resisting unreasonable demands of combined employés, because, first, it would soon be declared unlawful, and, second, such action would defeat its own ends. A motion in the Time Convention looking to any semblance of combination among roads for direct protection of their rights would be voted down so quickly as to take one's breath away. The officers of the Chicago, Burlington & Quincy can testify to the utter groundlessness of all the reports published in 1888, alleging that that company received assistance from other roads in resisting the demands of the striking engineers. The law has, indeed, permitted combination among "workingmen," although it probably would not tolerate it among corporations; but to what purpose? Any substantial successes that any class of railroad employes has gained by the aid of a brotherhood committee's argument could have been gained with equal ease by the aid of "home talent" alone if the men had seen fit to follow the dictates of simple common sense. It is true that unreasonable concessions have been extorted by brotherhoods from railroad companies in a number of cases; but how has this come about? It has not been owing to the forcible arguments of the employés nor to their impressive backing, either of men or money, but to lack of courage and firmness in railroad managers. Directors who are willing to stand a fight generally have officers who lack the skill to conduct it; and managers who have the sagacity to bring a controversy to a direct issue when the proper time comes, generally find themselves hampered by shortsighted directors, who insist on a compromise to protect present net earnings.

We have printed our correspondents' letters, however, not because we expect to solve the problem presented, but more particularly because they tell of facts that should be known and considered. We have not been unmindful of the conditions mentioned. If we have failed to call our readers' attention to them with sufficient frequency, or have talked about the remedies more than about the symptoms of the disease, it is because we believe the cure of this malady is to be found along the same lines as that of milder disorders, and because it is practice rather than preaching that is needed. Whenever a collision, derailment or other disaster caused by negligence or incompetency is important enough to attract general attention, we discuss its causes and remedies in the light of the best information we can get. A man or a hundred men who intend to cause similar disasters next year must be dealt with in substantially the same manner as the one who has already brought himself up for judgment; and we must go a step further and include in the same category those men whose general conduct is so negligent as to amount to intention. By similar disasters we mean those from similar causes. The brakeman who goes to sleep and causes the destruction of a few drawbars at a water station is generally found to be in practically the same class as the engineer who forgets train orders or the conductor who allows himself to be fooled by the stopping of his watch. In short, there is no sure way of disciplining 1,000 men,

except by 1,000 repetitions of the same methods that are used with one man.

A certain superintendent (whose work has been heretofore mentioned in these columns), who on taking his office found 300 out of his 500 freight brakemen to be "toughs," succeeded in clearing them out, and brought his whole force up to a good standard of efficiency in two years, and with only one small strike. From a study of his methods we are convinced that the same would apply as well to 5,000 men as to 500, and we have been unable to discover any plan that would apply to the larger force any better. These methods are not especially new, and have, in fact, been presented in these columns many times. They demand money, honorable and judicious subordinate officers, intimate knowledge of their men on the part of these officers and permanency of tenure. The first and last may be resolved into one, as lack of money is the main reason why division superintendents are not kept in their places longer. The direct money outlay for changes of methods is not very large, but still it is generally secured from the directors only by assiduous argument. The methods themselves include the premium system as practiced by the Fall Brook Coal Company and the Seattle, Lake Shore & Eastern. This would cost twenty times as much on a trunk line as on one of these small roads, but would not the results multiply in proportion? Another important element is constant and close inspection; another is sure punishment. Neglectful men are detected, not one time in 10 or 50, but *in a large majority of the serious cases.* This also costs money, but is it any more expensive than a similar degree of security in other departments, the financial, for instance? The rule as to punishment is rigid and, we may say, severe. Hard but infrequent, rather than little and often, is the rule. Favoritism seems to be at the minimum. The demand that a man shall fill his place or vacate it is *carried out.* Is there any way of securing success except in recognizing this principle? Does the fact that men are banded in brotherhoods make any difference in the conditions under which the work must be done? It is deplorable for an organization of employés to act dishonestly in defending its members, for such unfairness is as disgraceful as superciliousness or cruelty is in a superintendent; but this does not alter the manager's duty to enforce salutary discipline, though it may change the conditions somewhat.

January Accidents.

Our record of train accidents in December, given in this number, includes 106 collisions, 93 derailments and 12 other accidents, a total of 211 accidents, in which 46 persons were killed and 210 injured. The detailed list printed on another page contains accounts only of the more important of these accidents. All which cause no death or injury of persons are omitted, except where the circumstances of the accident as reported make it of special interest.

These accidents are classified as follows:

COLLISIONS:	
Rear	56
Butting	20
Crossing and miscellaneous	30
	—106
DERAILMENTS:	
Broken rail	9
Loose or spread rail	3
Broken bridge	2
Defective switch	1
Defective frog	1
Broken wheel	2
Broken axle	4
Broken truck	1
Fallen brakebeam	1
Broken car	1
Loose door	1
Loose wheel	2
Broken coupling	2
Boiler explosion	1
Misplaced switch	4
Runaway train	3
Trackmen	1
Cattle on track	5
Landslide	1
Ice	1
Malicious obstruction	4
Accidental obstruction	3
Purposely mispl. switch	2
Unexplained	38
	—93
OTHER ACCIDENTS:	
Boiler explosions	4
Cylinder explosions	1
Cars burned while running	3
Various breakages of rolling stock	3
Other causes	1
	— 12
Total number of accidents	211

The causes of collisions, where given, were as follows:

	Rear.	But- ting.	Crossing and other.	Tot'l.
Trains breaking in two	7	..	..	7
Misplaced switch	5	1	1	7
Failure to give or observe signal	5	1	4	10
Mistake in giving or understanding orders	1	6	..	7
Miscellaneous	18	2	14	34
Unexplained	20	10	11	41
Total	56	20	30	106

A general classification shows:

	Collisions.	Derailments.	Other.	Total.	P.c.
Defects of road	..	16	..	16	8
Defects of equipment	7	15	8	30	14
Negligence in operating	58	8	3	69	33
Unforeseen obstructions	..	16	1	17	8
Unexplained	41	38	..	79	37
Total	106	93	12	211	100

The number of trains involved is as follows:

	Collisions.	Derailments.	Other.	Total.	P. c.
Passenger	42	28	9	79	26
Freight and other	154	67	3	224	74
Total	196	95	12	303	100

The casualties may be divided as follows:

	Collisions.	Derailments.	Other Accidents.	Total.
KILLED.				
Employés	19	13	6	38
Passengers	8	..	..	8
Others	..	..	..	..
Total	27	13	6	46
INJURED.				
Employés	76	38	4	118
Passengers	61	29	..	90
Others	2	..	..	2
Total	139	67	4	210

The casualties to passengers and employés, when divided according to classes of causes, appear as follows:

	Pass. killed.	Pass. injured.	Emp. killed.	Emp. injured.
Defects of road	..	8	3	4
Defects of equipment	..	2	7	8
Negligence in operating	8	61	23	81
Unforeseen obstructions and maliciousness	..	3	1	3
Unexplained	..	16	4	16
Total	8	90	38	118

Thirty-one accidents caused the death of one or more persons each, and 54 caused injury but not death, leaving 126 (60 per cent. of the whole) which caused no personal injury worthy of record.

The comparison with January of the previous four years shows:

	1891.	1890.	1889.	1888.	1887.
Rear collisions	56	32	22	36	32
Butting "	20	24	17	34	17
Crossing and other ditto	30	20	6	2	5
Derailments	93	89	72	151	73
Other accidents	12	6	7	16	13
Total "	211	171	124	239	140
Employés killed	38	52	25	43	26
Others "	8	15	10	24	20
Employés injured	118	123	75	107	72
Others "	92	104	38	116	65
Passenger trains involved	79	67	40	118	73
Average per day:					
Accidents	6.81	5.52	4.00	7.71	4.51
Killed	1.48	2.16	1.13	2.16	1.48
Injured	6.77	7.32	3.65	7.20	4.42
Average per accident:					
Killed	0.218	0.392	0.282	0.280	0.328
Injured	0.995	1.327	0.911	0.933	0.978

All the passengers killed January met their deaths in collisions, five accidents under this head having inflicted fatal injuries. It will be noted that two of these collisions (rear) were on the busy lines leading into Chicago, and they draw attention to the crowded condition of nearly all the roads entering that city, and to the complicated problem, now being considered by the managers there, of providing methods of signaling to meet the great demand which it is expected the passenger traffic will make in 1893. The other fatal collisions were at Florence, Kan., on the 26th; Jamaica, N. Y., on the 14th, and Butte, Mont., on the 25th, the circumstances of which are given in our accounts as clearly as we have been able to get them. The last-mentioned case is an illustration of antiquated practice which still obtains to a large extent on roads of thin traffic in the far West. It is an interesting question, though, perhaps, only a speculative one, to what extent the improved rules and discipline on the more crowded lines of the East have induced improvement on the less important roads in the same territory. Although there is always cause for regret that trainmen on roads of light business have not that training—only to be had through experience—which is enjoyed by the men on busier roads, there can be little question that much is learned by these men who lack practice, from their better educated neighbors. Through changes of men from one road to another and conversations between men of different roads, as well as by means of newspaper reports, etc., no doubt much valuable instruction is conveyed; so that a road in the East doing a light business probably has a better grade of service than would a similar line located where there is nothing but precept to enjoin improved practice.

A bad rear collision at West Paterson, N. J., on the 1st, and a somewhat similar one at Wilmore, Ky., on the 6th, were caused by misplaced switches, and are, therefore, classed under the head of negligence; but there is said to be some evidence in both cases that the switches were maliciously misplaced. While no mere mechanical safeguard can thwart a determined train wrecker, it is yet a fact that cases of this kind are held by a great many experienced superintendents to be strong arguments for the more general introduction of distant signals for switches.

The engineer who was responsible for the rear collision at Scarboro, Me., on the 22d has been arrested. He was an old and experienced runner. The collision at North Concord, Vt., on the 7th was an exciting though, fortunately, not a very disastrous one; but the simple, almost trifling, character of its immediate cause is worthy of note. The man in charge of the rear car of the train simply failed to pay due heed to the time honored rule to stick to the last car.

The derailment near Kansas City on the 30th caused no deaths directly, but the account states that a stockman in the caboose, who was subject to heart disease, died of fright. We have not counted him as a victim of the collision. The derailment caused by a boiler explosion at Midland, Ky., on the 6th was reported all over the country as a failure of a trestle bridge, and was located at Stepstone instead of Midland. The Aztec limited express, on the Mexican National, was derailed by a misplaced switch on the night of the 21st, killing the engineer and fireman. A passenger train on the Pittsburgh, Cincinnati, Chicago & St. Louis killed 3 men on a hand car on the night of the 6th. On the 19th an engineer on the New York Central was killed near Sing Sing, N. Y., by striking a bridge while he leaned out of the cab window. The fireman did not become aware of the accident for several seconds or minutes afterward. In a quarry at Westport, N. Y., on the 14th, a carload of granite became uncontrollable and ran down a steep grade, killing 8 men. At Kansas City, on the 31st, a cable train became uncontrollable on the inclined road near the Union depot, and ran uncontrolled to the foot. The grip car was wrecked, but there were only two persons injured. At Sioux City, on the 20th, a street car was run into at a crossing by a switching engine, injuring two or three passengers.

The officers of the Pennsylvania lines west of Pittsburgh, after a long conference, have revised the regulations governing certain dealings with employés, in accordance with the terms of the general order printed below. Over 100 delegates from employés' organizations on various lines of the system have been in Pittsburgh for two or three weeks, and the newspapers have industrously spread reports that the men had serious intentions of precipitating a strike if they failed to get what they wanted. It is impossible to say what basis existed for making such predictions, but the committeemen have gone home, and there is nothing in the outcome which conflicts with the statement, made by several officers of the road, that there was at no time serious danger of a strike. The employés asked for an increase in pay and persistently urged their demand, and they say that the slight concessions which they have received are far from satisfactory. There is, nevertheless, no evidence that they claim their wages to be unreasonable as compared with those of men on other railroads. The new stipulations, which are in the form of a general order issued by the Division Superintendent, and apparently do not constitute an "agreement," are as follows, somewhat condensed:

The practice of imposing fines, or the custom of allowing employés to pay for loss of tools, and damage to rolling stock and company's property, will be discontinued, and discipline will be administered by suspension or discharge. Where investigations disclose that the men are deficient in their knowledge of the book of rules or machinery, an examination will be made thereon before the men are permitted to return to work.

Where men report for duty after being off on account of accident or sickness, and, in the judgment of the superintendent, a physician's certificate is necessary as determining the fitness of the man for service, such certificates must be furnished. Callers will call the trainmen one hour before leaving time. . . .

When trainmen are called for duty and their trains are annulled, two hours will be allowed at overtime rates, and men will report in when trains are annulled and register ahead of any not yet called. If called and notified of the annulment of train before reaching yard or engine house, no time will be allowed. Trainmen sent away to attend court as witnesses in the company's interest will be paid the regular trip rate for each day or part thereof, and actual living expenses while engaged in such service.

In making light and dead trips men will be paid as follows: Light engine and caboose, full through freight time; light engine or caboose attached to a freight train, full through freight time, and the deadhead crew will be expected to assist in the work. Deadheading on passenger trains, one-half their regular trip rates. . . .

As a general practice, it is not deemed advisable to transfer yard enginemen to road service. Where such transfers are made the yard enginemen will first be required to run on the road six months as firemen. Their service as enginemen in the yard will be used in fixing their classification.

The watching of engines by firemen at terminals is a part of the duties of a round trip, and is covered by the rate for that trip. In cases where the firemen have to perform the duties of watchmen after the trip is ended compensation will be made, provided it is not already covered by the overtime allowances. Firemen will be required to wipe fixtures inside of cab, and wipe jacket, bell and number plate, clean windows and keep engine looking generally neat. The care that a fireman takes of his engine is a part of his duty, and is duly considered when he comes up for promotion. . . .

Employés held off, pending an investigation, shall be given a trial as soon as it can be arranged. In cases where the men are found innocent, such allowances will be made as seems to be equitable.

The new rules are but slightly different from the old. For lost tools or the damaging of machinery, it has been the practice to charge on some divisions, on others not. The men gain in the matter of deadhead trips. Formerly they received half time, now full freight time.

The cultured and aristocratic states of the East are practically so close to the effete but educated nations of the old world, in spite of the three thousand miles of salt water intervening, that æsthetic and classical notions are easily propagated, the ordinary populace as well as the upper ten (or upper 400) readily acquiescing in any reasonable innovation of the kind. The truth of this assumption is seen in the quiet and serene way in which numerous railroads, particularly those centering in the city near Harvard University, have painted the words "Men" and "Women" on the doors of their waiting rooms and other places; thus at a single stroke extinguishing the nasty horde of "gents" and other wearers of "pants," and conferring upon society a great boon. Anglo-Saxon directness, Jeffersonian simplicity and a dozen other meritorious features are combined in this new departure, and it is not to be wondered at that the fashion has spread like fire, so to speak. But it has, we fear, spread a little too far, and it must be warned

to halt. Important news reaches us from Texas. The chivalric people of that state are touchy on these points, and railroad officials must "go slow." It is now a number of years since the 10 horse thieves on a Texas jury, which was trying one of their own kidney, inquired of the two respectable but obstinate men sitting with them how long they deemed it proper for "two blokes to waste the time of 10 gentlemen;" but the spirit of chivalry still remains, and we read in a Texas paper of recent date a card, signed in small capitals, by 12 prominent citizens of the town of Temple, exonerating the superintendent of a railroad down there from the grave charge that he had remarked that there were no ladies or gentlemen in Texas. This superintendent adopted the Boston style for his waiting-room doors and supposed he was doing society in the Southwest a real service; but the gossips floored him, and he would still be down but for these 12 magnanimous citizens. He only escaped "by the skin of his teeth," however, and we doubt not he has been properly impressed by the warning and will hereafter take care. He was carrying Eastern refinements to a region which was not quite ready to receive it. On all the facts being made public, the 12 citizens aforesaid triumphantly vindicated him; but we fear that they still have before them a tedious task in spreading "Republican ideas" with sufficient thoroughness to insure the permanency of the new inscriptions on the waiting rooms at Temple. Still when Texas does seriously take hold of Culture "she'll make her hum."

The Railway Companies' Association of Great Britain, in response to a letter from the Board of Trade, calling attention to excessive hours of work, has, after a two months' delay, sent a reply, of which the substance is the following:

All railway companies have in force regulations with the object of restricting the hours of duty of all classes of their servants engaged in the working of trains within such limits as experience has shown to be within the fair daily capacity of the men. The companies are aware that some classes of servants, particularly drivers, firemen, and guards of goods trains, are frequently employed for unduly long hours, owing mainly to the detentions in sidings or at junctions. These detentions are most injurious to the companies, who have every interest on financial as well as all other grounds to reduce them. Detentions of this character are partially due to the increasing precautions adopted for the safe and punctual working of passenger trains, and are very largely affected by any sudden pressure of traffic or by difficulties arising from foggy or stormy weather. It is the constant study of railway managers to make such arrangements as will reduce these delays, and heavy capital outlay is being constantly incurred upon the main lines of railway with this object.

The Board of Trade called attention to numerous instances of accidents where the men at fault had been on duty too long; but the vital question in the matter, that whether the employés are *habitually* kept on duty such long hours that *occasional* excessive work demanded by emergencies burdens them too frequently or too many hours at a time, is not touched upon. The inexorable law of supply and demand has such full play in England that an increase of pay or reduction of work can be accomplished, if at all, only by most carefully prepared measures. The pay per hour being very low, the men naturally desire to work as many hours each day as the limit of their physical energies will permit. The companies have little inducement, except sentiment, to shorten hours, and would meet with serious obstacles if they tried it, unless at the same time they raised the pay per hour. This they cannot be arbitrarily compelled to do, even by act of Parliament. A bill has been drawn up since the Scotch strike, providing for a more thorough investigation of the hours of trainmen's work, and empowering the Board of Trade to compel the adoption of schemes for shorter hours where investigation shows that men are overworked, but we do not know what chance it has of passing. The proposed law also gives employés of railroads, who occupy the employers' houses, three months' tenure after notice to vacate. The difficulties in Scotland were aggravated by evictions of employés from the dwellings they occupied.

The Interstate Commerce Commission has issued the full text of its fourth annual report, which was noticed, on the appearance of the advance sheets, in the *Railroad Gazette* of Dec. 12. The appendices contain abstracts of the decisions of the Commission during the year, and briefer abstracts of all important decisions since the organization of the board. Auditor McCain has made a quite extensive report on the changes in freight classification and rates on the roads of the country since the establishment of the Commission. His conclusion is that the tendency throughout the country is downward, and that this tendency is largely due to the Interstate Commerce law. Appendix E, covering 40 pages, gives full abstracts of the railroad laws in all the states, with notes stating what important subjects are left without legislative regulation. Appendix G, covering over 50 pages, gives an abstract of legislative railroad regulations in Great Britain and various other European countries. Appendix H gives information gathered from railroad commissioners and railroad officers all over the country concerning ticket brokerage. The special agent of the Commission, in reporting what he found out about scalpers in Chicago, says that, of the 15 scalpers in that city, over half were purchasing from 150 to 200 two-thousand mile books weekly, so that it was estimated that each scalper made a weekly profit of from $1,200 to $1,600 on these alone. Nine scalpers in Cincinnati spent $13,000 per year for rent and clerk hire. Appendix I contains an account of the Counselman and other cases before the United States Court at Chicago, in which railroad officers refused to testify about rate cutting.

Some time since we noted the fact that Mr. Edward Bates Dorsey was endeavoring to promote the building of a railroad in South Africa. A private letter recently received from him says that the project is for the present dropped. The road projected was an interior one, running through a very rich farming country, which could export a good deal of wheat if supplied with transportation to the sea. The only way to the coast is through Cape Colony or Natal. As both of these colonies own the railroads through them they would not name a freight rate on their lines sufficiently low to allow the shipment of grain, nor would they give permission to build a new line to the coast, as they could not authorize the construction of a road that would compete with the existing government lines. This is an illustration of some of the disadvantages of government ownership of railroads, particularly in new countries.

It will be remembered that the Massachusetts Railroad Commissioners, in their annual report published a year ago, strongly urged the roads of that state to consider the advisability of adopting the standard code of train rules as promulgated by the Time Convention; calling attention, at the same time, to the unsatisfactory character of the regulations on some Massachusetts roads. After the lapse of a year the Boston & Albany, which may be regarded as the mountain among Massachusetts roads, has brought forth a mouse, which consists of a manifold form for use in giving freight trains the right of road when a passenger train is late. Manifolding is new on that road, and this form is an improvement over the road's former practice; but yet it is about 20 years behind the times, and far inferior to the simple Form E in the standard code. There would seem to be still room for the use, on the part of the Massachusetts commissions, of a liberal quantity of "persuasion and entreaty, agencies congenial to it."

General Manager Haines, of the Savanah, Florida & Western and other roads in the Plant System, has issued a book of "General Rules" in which various subjects not coming under the head of train rules as given in the standard code, are arranged in an orderly manner and indexed. This book embraces the orders heretofore printed in a less desirable form in the back of the time table, and puts the matter in very convenient shape. A considerable portion of the space is taken up with state and national laws and with rules for the guidance of claim departments, superintendents, paymasters and other heads of departments whose duties are not generally published for the benefit of all employés; and the utility of the work cannot be accurately estimated off-hand. All operating officers should, however, be interested in it, as it must offer suggestions of value on almost any road, and we trust Colonel Haines has provided sufficient spare copies to supply his friends.

The British Board of Trade issues a circular giving the names of roads to which it has sent orders under section 1 of the Regulation of Railways Act of 1889. This section authorizes the board to compel the adoption of block signaling and interlocking on passenger lines, but the circular does not give the terms of the orders issued, though it is to be presumed that the notice is the same to all the roads, except, possibly, in the length of time given for compliance. The list published includes the names of practically all the roads in the United Kingdom.

The elevated roads of New York carried on Feb. 19, the day of General Sherman's funeral, a total of 665,379 passengers. On the occasion of the centenary of Washington's inauguration, April 30, 1889, the number carried was 835,721; and on April 29 and May 1, 746,000 and 756,000, respectively, were carried.

The St. Paul and Minneapolis Rate Association, in issuing its spring rate sheet, which will go into effect about March 16, takes definite action toward the abolition of unlimited joint rates by resolving that all tickets to Pacific Coast points that are now sold at unlimited rates shall be limited for 30 days.

NEW PUBLICATIONS.

The Basic Bessemer Process. By Dr. H. Wedding. Translated from the German by William B. Phillips, Ph. D., and Ernest Prochaska. New York Scientific Publishing Co., 1891. Price $3.50.

The general principles of the basic Bessemer process are well known; indeed, the conditions of slags favorable for dephosphorization of iron, rich in that objectionable metalloid, were pointed out as early as 1857 by Gruner, and many efforts were subsequently made to utilize the beneficial effects of basic fluxes; but the difficulty of securing a basic lining that would stand baffled all inventors until Sidney Gilchrist Thomas, in 1878, hit upon the fortunate expedient of making basic bricks of dolomite and fire clay. This solved the problem, and it only remained to perfect the details, which has been done in Germany, and it is from the pen of a German that we now accept instruction in a process destined to be of immense importance in the industrial development of extensive areas of our own country. One of the chief advantages of this process of steel making lies in the circumstance that the reduction in phosphorus will be from 95 per cent. to 98 per cent., no matter if the range of phosphorus content in the mixture used varies from 1 per cent. to 2 per cent. The following table presents the limiting percentages of various ingredients, within which limits success may be confidently anticipated, as determined in German practice:

Phosphorus	from 1.2 per cent.	to	2.0 per cent.
Sulphur	" traces	"	0.15 per cent.
Manganese	" "	"	1.50 per cent.
Silicon	" 0.5 per cent.	"	1.50 per cent.

An increase in the amount of sulphur is allowable if the quantity of manganese is increased, so as to maintain from 1 per cent. to 1.50 per cent. Mn. for every 0.15 per cent. S in the mixture. The extremely low limit of silicon will doubtless be a surprise to many. It is evident that we had expected too much of the basic process; that its limits are narrower than had been supposed, and particularly in regard to the phosphorus content. Thomas' expectations that his process would prove adapted to irons with a medium amount of phosphorus have not been realized; but this cannot be regarded as detracting from the great importance of the method, and in a certain sense it simplifies it, as the phosphorus constitutes a valuable fuel in the converter. It happens that at this moment the Adams' method is promising good results, showing the remarkable reduction of 33⅓ per cent. of phosphorus from a mixture carrying only 0.048 per cent. of this ingredient. We shall not then be tempted to strain a point to fit the basic process to conditions too dangerously near the line of possible failure.

There can be no doubt that this book is timely. It tells the thinking metallurgist plainly how he may exploit many mines which have lain unworked, and the conditions for success in every stage of the process are so explicitly given, the diagrams and illustrations of plants and apparatus in actual operation so ample, and the details of manipulation so carefully stated, that the practical metallurgical engineer could with confidence project and establish new works with its aid. But it is not a book for the novice. It presupposes a thorough familiarity with the acid process.

This method will doubtless be improved in many particulars as it becomes adopted in this country, and one hint thrown out should not be lost upon American inventors—viz., that a water-jacketed, metal-lined converter would serve equally well if some means could be found for averting explosions in the event of a scaling off of the inner crust which forms when such a lining is employed.

The arrangement of the work is excellent, and its value is enhanced by notes and by an excellent supplementary chapter by Ernst Prochaska on dephosphorization in the basic open-hearth furnace.

Compound Locomotives. By Arthur T. Woods, Professor of Mechanical Engineering University of Illinois. New York: R. M. Van Arsdale. 1891. 12mo, pp. 167. Index. Price, $2.

This is a reprint of papers which have appeared in the *National Car and Locomotive Builder* within the last year and a half. The author says that it has been his aim to combine the descriptions of the various forms of compound locomotives which have been actually used with so much of the theory of the design of compound engines as would seem to be directly applicable to locomotive practice. He has endeavored to give an unprejudiced analysis of each type without expressing a final opinion as to the merits of either. The best known systems up to the time of publication of the work are described, including the Worsdell-Von Borries system, the Mallet two-cylinder type, the Lindner type, together with various three-cylinder and four-cylinder engines. The final chapter is a summary of the various American designs up to July, 1890, and the whole work is a clear, compact and excellent epitome of this phase of locomotive building.

TECHNICAL.

Manufacturing and Business.

The Marden Car Brake Co. has removed its offices to the new Exchange Building, 53 State street, Boston.

The American Railway Equipment Co., Limited, of New York, which is very well known in the railroad trade, this week changed its corporate name to The Wells & Coutan Co., Limited, the offices being at 66 John street, New York City. O. C. Wells is Secretary and General Manager and Charles A. Coutan is Treasurer.

The Consolidated Car Heating Co. is exhibiting at the Phenix Building, Chicago, some extremely good models of its different methods of heating cars with steam and water; the commingler, disk, direct steam, etc., systems being shown in detail and in operation. The steam and water pipes of the models being of glass, the movements of the water and steam may readily be seen and the advantages of these systems determined upon. An inspection of these models by all interested in the subject is recommended.

William Tod & Co., of Youngstown, O., have orders for constructing seven Porter-Hamilton engines, of an aggregate of 700 h. p., for the Cleveland Rolling Mill Co. and other industrial plants, and are running extra time in their constructing departments to fill orders for heavy rolling mill and furnace machinery for new plants. The firm has under construction rail mill tables and hydraulic machinery for the Pennsylvania Steel Co.

Iron and Steel.

The Pennsylvania Tube Co., of Pittsburgh, is erecting a warehouse 100 × 400 ft., built entirely of iron.

The Hainsworth Steel Co. made a partial trial of its new blooming mill on Monday of last week, which is reported to have been quite satisfactory.

The Sterling Steel Co., whose works are located at Demmler Station, Pa., has built a new boiler house and added to its steam plant a battery of four boilers.

The Ellis & Lessig Iron & Steel Co.'s works, at Pottstown, Pa., have resumed. In the puddling department, where the strike throwing 700 men out of employment was originally inaugurated, eight puddling furnaces were started. The nail factory also resumed. The men are working at the reduction.

The Consolidated Car Heating Co.

This company has issued a general invitation to railroad men to inspect its appliances in use upon the Belt Line trains, running between Albany and Troy, Wednesday and Thursday, March 11 and 12. Trains equipped with automatic temperature regulator and the commingler storage system will leave the Union Depot at Albany, March 11 and 12, at hourly intervals, from 9.30 in the morning to 4.30 in the evening. Trains equipped with the Sewall coupler will leave on the even hours from 10 to 4. Representatives of the company will be at the depot during each day, and will furnish transportation. Lunch will be served at the Albany Club to all guests from 12.30 to 2 p. m.

The company sends a list of 51 different roads using the Sewall steam coupler. The mileage of these roads is 38,070 miles, and the equipment 7,542 passenger cars. The McElroy and other couplers of the Consolidated Car Heating Co. are in use on roads having a mileage of upward of 8,000 miles.

A Safety Heater.

The Consolidated Car Heating Company's "fire-proof" heater is reported to have shown good behavior in a wreck at Remington, O., on Feb. 23, where train No. 7 of the Baltimore & Ohio Southwestern, sidetracked for No. 4, was not pulled into the turnout quite far enough, and No. 4 came on at such speed that it was impossible to stop, and ran into it. The engine of No. 4 scraped the side of the third car of No. 7 for about 12 ft., and, striking the fourth car at the corner, turned it over on its side into the ditch. The conductor and several passengers were injured. This car was equipped with the above-named heater, which was located in the corner struck by the engine. Though the heater was somewhat loosened from its fastenings, lifted and tipped, it was but slightly broken; and notwithstanding a brisk fire was burning in it, no conflagration took place. Had the car been equipped with an ordinary heater, the train men say nothing could have prevented the car from burning.

LOCOMOTIVE BUILDING.

The Brooks Locomotive Works are building 12 locomotives for the Wisconsin Central.

The Winona & Southwestern will probably soon let the contracts for building five locomotives.

The Cleveland & Canton has recently ordered seven locomotives.

CAR BUILDING.

The Cleveland & Canton will soon order 300 coal cars, 60 stone cars, and probably some passenger cars.

BRIDGE BUILDING.

Atlanta, Ga.—Contracts will be let March 11 for the construction of about 445 ft. of trestling at the Chattahoochee River bridge, by County Commissioners.

De Beque, Col.—The State Assembly has before it a bill to appropiate $25,000 for a bridge at this place.

Des Moines, Ia.—The following proposals for erecting the Walnut street bridge were opened by the Board of Public Works: Geo. E. King Bridge Co. $32,344; Chicago Bridge & Iron Co., $32,500; Wisconsin Bridge & Iron Co., Milwaukee, $35,834; A. Y. Bayne & Co., Massillon, O., $42,543; King Iron Bridge Mfg. Co., Cleveland, $34,-299; Wrought Iron Bridge Co., Canton, O., $41,800; Smith Bridge Co., Toledo, $38,030; Des Moines Mfg. & Supply Co., $41,995; Clinton Bridge & Iron Co., $36,981; Variety Iron Works, Cleveland, $39,828; Pittsburgh Bridge Co., $38,000; Youngstown Bridge Co., $34,975; Milwaukee Bridge & Iron Co., $37,775.

Duluth, Minn.—A committee has been appointed by the City Council to confer with a committee from Superior in regard to building a bridge to connect Connor's and Rice's Points.

Grand Trunk.—This company is calling for tenders for iron bridge work for bridges on the Great Western Division and on the Northern & Northwest Division. Bids will be received for the various classes of iron bridges required upon these respective divisions up to March 14. Plans and specifications can be obtained from Mr. Hobson, Chief Engineer Great Western Division, Hamilton, Ont., and Mr. Holgate, Chief Engineer Northern & Northwestern Division, Allandale, Ont.

Kansas City, Mo.—F. J. O'Flaherty, County Surveyor, will let on March 7 the contract for three iron bridges, one 80 ft., one 60 ft., and one 40 ft.

Minnesota.—Bills have been introduced in the State Legislature appropriating funds for building bridges in the following three counties: Two in Otter Tail County, in Kittson County and in Todd County. The bills have been referred for report.

Newtown, N. Y.—The Queens County Board of Supervisors has appropriated an additional $25,000 to build a new drawbridge across the Newtown Creek to connect Newtown and Williamsburgh. Half the expense will be borne by Kings County.

Philadelphia, Pa. The bill to appropriate $30,000 for constructing the Oxford street bridge has been reported favorably to the Council by the Survey Committee.

Rigaud, Ont.—The Montreal & Ottawa has just had completed a very fine masonry bridge at Rigaud, consisting of four piers and two abutments, with iron superstructure, and spanning the river A La Graisse. The piers are about 40 ft. in height, and are of red sandstone of a peculiar color, and very solid. The plans were prepared by Mr. James Shanly, Chief Engineer of the road. The contractors were Hendershot & Breckon, of Montreal.

Rochester, N. Y.—A bridge may be erected across the tracks of the New York Central & Hudson River at University Place.

Winnipeg, Man.—The Norwood Bridge Co. is applying to the Legislature of Manitoba for incorporation to erect a bridge over the Red River from a point in the city of Winnipeg, south of the junction of the Assiniboine and Red Rivers and near Kennedy avenue to a point opposite.

MEETINGS AND ANNOUNCEMENTS.

Dividends.

Dividends on the capital stocks of railroad companies have been declared as follows:

Atlanta & Charlotte Air Line, semi-annual, 3 per cent., payable March 6.

Boston & Albany, quarterly, 2 per cent., payable March 31.

Chicago & Eastern Illinois, quarterly, 1½ per cent. in cash, payable April 1.

Chicago & Northwestern, quarterly, 1¾ per cent. on the preferred stock, payable March 24.

Cleveland, Cincinnati, Chicago & St. Louis, quarterly, 1¼ per cent. on the preferred stock, payable April 1.

Delaware & Hudson Canal Co., quarterly, 1¾ per cent., payable March 16.

Little Miami, quarterly, $1 per share, payable March 16.

West Jersey, semi-annual, 3½ per cent. in scrip, payable March 16.

Meetings.

Meetings of the stockholders of railroad companies will be held as follows:

Alabama Midland, annual, Montgomery, Ala., March 7.

Atlanta & Charlotte Air Line, annual, 48 Wall street, New York City, March 11.

Bedford & Bloomfield, annual, 47 Broadway, New York City, March 11.

Central New England & Western, special, Room 37, 115 Broadway, New York City, March 23.

Cincinnati & Muskingum Valley, annual, Zanesville, O., March 24.

Crystal, annual, St. Louis, Mo., March 10.

Elizabethtown, Lexington & Big Sandy, annual, Lexington, Ky., March 18.

Fort Worth & Rio Grande, annual, Forth Worth, Tex., April 7.

Grand Rapids, Chicago & St. Louis, annual, Grand Rapids, Mich., March 18.

Illinois Central, annual, Chicago, Ill., March 11.

Kansas City, Clinton & Springfield, annual, Kansas City, Mo., March 11.

Kansas City, Fort Scott & Memphis, annual, Kansas City, Mo., March 11.

Kansas City, St. Louis & Chicago, annual, St. Louis, Mo., March 10.

Kentucky Central, annual, Covington, Ky., March 17.

Louisville, New Albany & Chicago, annual, 47 Broadway, New York City, March 11.

Missouri Pacific, annual, St. Louis, Mo., March 10.

Montreal & Sorel, annual, Montreal, Que., March 10.

Morristown & Cumberland Gap, special, Morristown, Tenn., April 9, to act upon a proposed increase of capital stock.

New York & New England, annual, 88 Tremont street, Boston, Mass., March 10.

Norfolk & Ocean View Railroad & Hotel Co., annual, 31 Bank street, Norfolk, Va., March 23.

Northwest & Ottawa, special, Montreal, Que., March 17, to authorize an issue of bonds.

Oregon Short Line & Utah Northern, annual, Salt Lake City, Utah, March 18.

Ottawa, Arnprior & Renfrew, special, Ottawa, Ont., March 16.

Pennsylvania, annual, Musical Fund Hall, Locust street, Philadelphia, Pa., March 10.

St. Louis, Iron Mountain & Southern, annual, St. Louis, Mo., March 10.

Tennessee Coal, Iron & Railroad Co., biennial, Tracy City, Grundy county, Tenn., April 7.

Texas & Pacific, annual, 195 Broadway, New York City, March 18.

West Virginia & Pittsburgh, special, Weston, W. Va., March 25.

Railroad and Technical Meetings.

Meetings and conventions of railroad associations and technical societies will be held as follows:

The *New England Railroad Club* meets at its rooms in the United States Hotel, Beach street, Boston, on the second Wednesday of each month, except June, July and August.

The *Western Railway Club* holds regular meetings on the third Tuesday in each month, except June, July and August, at the rooms of the Central Traffic Association in the Rookery Building, Chicago, at 2 p. m.

The *New York Railroad Club* meets at its rooms, in the Gilsey House, New York City, at 2 p. m., on the third Thursday in each month.

The *Central Railway Club* meets at the Hotel Iroquois, Buffalo, the fourth Wednesday of January, March, May, September and November.

The *Northwest Railroad Club* meets on the first Saturday of each month, except June, July and August, in the St. Paul Union Station at 7:30 p. m.

The *Northwestern Track and Bridge Association* meets on the Friday following the second Wednesday of each month at 7:30 p. m. in the directors' room of the St. Paul Union Station, except in the months of July and August.

The *American Society of Civil Engineers* holds its regular meetings on the first and third Wednesday in each month, at the House of the Society, 127 East Twenty-third street, New York.

The *Boston Society of Civil Engineers* holds its regular meetings at the American House, Boston, at 7:30 p. m., on the third Wednesday in each month.

The *Western Society of Engineers* holds its regular meetings at 78 La Salle street, Chicago, at 8 p. m., on the first Wednesday in each month.

The *Engineers' Club of St. Louis* holds regular meetings in the club's room, Laclede Building, corner Fourth and Olive streets, St. Louis, on the first and third Wednesdays in each month.

The *Engineers' Club of Philadelphia* holds regular meetings at the House of the Club, 1,122 Girard street, Philadelphia, on the first and third Saturday, of each month, excepting in January, when the annual meeting is held on the second Saturday of the month. The second January meeting is held on the third Saturday. The club stands adjourned during the months of July, August and September.

The *Engineers' Society of Western Pennsylvania* holds regular meetings on the third Tuesday in each month, at 7:30 p. m., at its rooms in the Penn Building, Pittsburgh, Pa.

The *Engineers' Club of Cincinnati* holds its regular meetings at 8 p. m. on the third Thursday of each month in the rooms of the Literary Club, No. 24 West Fourth street, Cincinnati.

The *Civil Engineers' Club of Cleveland* holds regular meetings on the second Tuesday of each month, at 8:00 p. m., in the Case Library Building, Cleveland. Semi-monthly meetings are held on the fourth Tuesday of the month.

The *Engineers' Club of Kansas City* meets in Room 200, Baird Building, Kansas City, Mo., on the second Monday in each month.

The *Engineering Association of the South* holds its monthly meetings on the second Thursdays at 8:00 p. m. The Association headquarters are at Nos. 63 and 64 Baxter Court, Nashville, Tenn.

The *Denver Society of Civil Engineers and Architects* holds regular meetings at 36 Jacobson Block, Denver, on the second and fourth Tuesday of each month, at 8 o'clock p. m., except during June, July and August, when they are held on the second Tuesday only.

The *Civil Engineers' Society of St. Paul* meets at St. Paul, Minn., on the first Monday in each month.

The *Montana Society of Civil Engineers* meets at Helena, Mont., at 7:30 p. m., on the third Saturday in each month.

The *Civil Engineers' Association of Kansas* holds regular meetings at Wichita on the second Wednesday of each month, at 7:30 p. m.

The *American Society of Swedish Engineers* holds meetings at the club house, 250 Union street, Brooklyn, N. Y., and at 347 North Ninth street, Philadelphia, on the first Saturday of each month.

The *Engineers' Club of Minneapolis* meets the first Thursday of each month in the Public Library Building, Minneapolis, Minn.

American Railway Master Mechanics' Association.

The committee appointed to investigate the relative value of iron and steel for locomotive and car axles requests information on the following questions: If you have had any steel or iron axles break under locomotives or cars, please give the original diameter and also the diameter and mileages at the time of the fracture. If the axle was steel, please say if open hearth, Bessemer or crucible. If iron, give the formula for making the billet, and whether muck bar or scrap. 2. In practice do you find that steel axles give more service than iron between turnings? Please give the comparative mileages of the two, and also say if open hearth, Bessemer or crucible, and if scrap or muck bar. Answers to be sent as soon as possible to Mr. John Mackenzie, Superintendent of Motive Power, New York, Chicago & St. Louis Railway, Cleveland, O.

Denver Society of Civil Engineers.

The society has issued a programme giving the titles of papers which are promised for at its meetings during the coming year. Among those announced are: April 14, The Proper Use of Metal in Bridges, by H. L. Aulis, H. C. Jenning and W. R. Hand; May 12, The Electrical and Cable Railroads of Denver, by R. C. Simons, E. C. Hawkins, V. Spangberg and A. I. Fonda; Oct. 27, Maintenance of Way, by W. Ashton, W. A. Balcom, C. B. Pease and C. A. Sjogren; Nov. 10, The Application of the Abt System to Mountain Railroads, by W. B. Lawson, R. E. Briggs and T. M. Field; Dec. 8, Distance vs. Grade in Railroad Construction, by R. B. Stantor and H. A. Sumner, and also High Iron Trestles, by P. Reardon, G. H. Angell and E. P. Martin. The officers of the society are: George G. Anderson, president; J. S. Titcomb and R. D. Hobart, vice-presidents, and George H. Angell, secretary and treasurer.

Engineers' Club of Cincinnati.

The regular monthly meeting of the club was held on the 19th inst., with an attendance of 26 members. Two new members were elected, and six applications for membership were presented. The following question from the question box elicited considerable discussion: What is the most equitable method of assessing and collecting the cost of street improvements? In other words, should such improvements be paid for out of the general fund or by assessing the cost upon abutting property, or by some other method? Colonel Latham Anderson read an interesting paper on sanitary plumbing under the title of "The Single Trap System of House Drainage." The paper was discussed at some length by Mr. Hobby and by other members.

Engineers' Club of Philadelphia.

A business meeting was held Feb. 21, 45 members being present. The report of the Committee on Revision of the Constitution and By-Laws was presented and adopted.

The Secretary presented for Mr. Percy C. Osborne a large view of the Rivermont Bridge at Lynchburg, Va., accompanied by a description of the structure. Mr. Rudolph Hering presented a paper upon the Action of Sea Water on Steel and Iron, which will be continued by the author at the next meeting of the club.

New England Railroad Club.

The annual meeting of the club will be held at the State Hotel, Boston, Wednesday, March 11, at 7.30 p. m. The following are subjects for discussion: Screw Stay Bolts for Locomotives; Size of Bolts for Use at a Working Pressure of 175 lbs.; Distance Between Bolts; What is the Proper Way to Inspect Stay Bolts; Best Material for Stay Bolts; What Should be the Test of a Standard Stay Bolt, size 1 in. diameter, Elastic Limit and Tensile Strength?

New York Electrical Society.

The 135th meeting of the New York Electrical Society will be held in Professor Chandler's room at Columbia College, Forty-ninth street and Fourth avenue, on Friday, March 6, at 8 p. m. Mr. Chas. E. Emery, Ph. D., the well-known engineer, will deliver a lecture on "The Utilization of the Forces of Nature," which will be profusely illustrated by lantern.

Rensselaer Polytechnic Institute.

A lecture on American Rail Mills was delivered by Capt. Robt. W. Hunt, Prest. Am. Soc. Mech. Engs. and Trustee of the Rensselaer Polytechnic Institute, before the students of that institution on Feb. 24.

At a regular meeting of the Rensselaer Society of Engineers Feb. 27, R. A. Cairnes, C. E., City Engineer of Waterbury, Conn., delivered a lecture on "Sewerage." There were present 30 members of the society and 35 guests.

Western Society of Engineers.

A meeting of the society was held at its rooms, 78 La Salle street, on Wednesday evening, March 4. Mr. R. P. Morgan's resolution to change the name of the society to the Chicago Society of Civil Engineers was a "special order" for this meeting. A paper on "The Artesian Water-works at Memphis, Tenn.," was presented by Mr. T. T. Johnston.

PERSONAL.

—Mr. F. W. Dean, Mechanical Engineer, announces a change of his address from 27 School street to 53 State street, Boston.

—Mr. A. M. Stewart, for the last 15 years General Live Stock Agent of the Cleveland, Cincinnati, Chicago & St. Louis road, has resigned that position.

—Mr. N. A. Sager, Assistant Chief Engineer of the Toledo & Ohio Central, has resigned to accept the position of City Engineer of Bucyrus, Ohio.

—Mr. S. C. McComb, Assistant Engineer of the West Jersey and Camden & Atlantic roads, died suddenly of heart disease at his home, in Woodbury, N. J., last week.

—Mr. N. B. Palmer, General Accountant of the Pennvania Co., died at Fair Oak, Pa., Feb. 24. He was 46 years old and had been connected with the Pennsylvania for 25 years.

—Mr. William Findlay Shunk has been selected by the Intercontinental Railway Commission to take general charge of the survey work for the railroad to connect the systems of North and South America.

—Mr. N. P. Ramsey, Auditor of the Dayton, Fort Wayne & Chicago, has been appointed General Manager of the Cincinnati, Wabash & Michigan. Mr. Norman Beckley, the late General Manager, has been appointed Treasurer of the road.

—Mr. George H. Ross, Superintendent of car and special freight service of the Chicago, Burlington & Quincy, resigned that position this week, and the office has been abolished. The office of Superintendent of Telegraph, which has been vacant since the resignation of Mr. W. W. Nichols, has also been abolished.

—Mr. J. N. Osgood, Chairman of the Western and Northwestern divisions of the Western Freight Association, has resigned the office and will sever his relations with the association at its next meeting. The various divisions of the association will probably be consolidated under Chairman Midgeley, of the Western Traffic Association.

—Mr. Hugh T. Inman is mentioned as the probable successor of Gen. E. P. Alexander as President of the Central Railroad & Banking Co., of Georgia. Mr. Inman is a brother of Mr. John H. Inman, President of the Richmond & West Point Terminal, and is a man of recognized ability in the South. He is a director in several of the Richmond Terminal properties.

—Col. J. H. Averill, Superintendent of the Port Royal & Western North Carolina division of the Central of Georgia, has resigned and has been succeeded by Mr. B. C. Epperson, until recently Division Superintendent of the Louisville & Nashville. Col. Averill has been Superintendent of the Port Royal division over a year. He will take a well-earned rest, the first extended absence from business affairs which he has had in 17 years.

—Mr. Charles H. Low, Secretary, and until the late reorganization Auditor of the Baltimore & Ohio Southwest, died somewhat unexpectedly at his home, in Madisonville, O., last week. He had been long a victim of Bright's disease, but a two months' trip to California, from which he had just returned, was supposed to have done him much good. Mr. Low was about 60 years old, and had been an officer of the road under all its administrations.

—Mr. Henry K. Enos, President of the Missouri, Kansas & Texas, died in New York City last week from pneumonia. He had been sick about four weeks, suffering at first from an attack of typhoid fever. Mr. Enos was about 53 years old, and had been prominent for many years in New York as a banker and stock broker. Soon after the Missouri, Kansas & Texas defaulted in 1888 he became connected with its management, being elected a director and subsequently President, and he had shown much executive ability in that position.

—Mr. John H. Hall, President of the Georgia Company, and a director of several of the Southern roads, died at Thomasville, Ga., March 3, of pleurisy. Mr. Hall left New York a few weeks ago for a Southern trip with Mr. Jay Gould and Mr. J. H. Inman. Mr. Hall became a director of the New York Elevated road when it was projected, and continued a director of the Manhattan after the consolidation. He was a director of the Richmond & Danville and Richmond & West Point Terminal.

—Mr. James E. Cross, General Eastern Agent of the Adams & Westlake Co., died very suddenly in New York City, Feb. 27, while passing through the street on his way to the train. His death was doubtless from heart disease. Mr. Cross was born in Virginia in 1823, and had been connected with the manufacturing interests of Chicago for the last 30 years. He was a senior partner of the firm of Cross, Dane & Westlake, which was afterward merged into the Adams & Westlake Co. He had represented that company in the East for 12 years. He was very widely known and respected among railroad men. His many good qualities had endeared him to a host of friends. He was warmly attached to his home, and was an affectionate husband and father. His remains were brought to his late residence, 2,941 Prairie avenue, Chicago.

ELECTIONS AND APPOINTMENTS.

Baltimore & Eastern Shore.—The stockholders met at 6 South street, Baltimore, Md., Feb. 25, and elected a new board of directors as follows: Joseph B. Seth, E. E. Jackson, Theophilus Tunis, Chas. C. Pomeroy, Allen W. Evans, A. E. Godeffroy, Francis Howe, Geo. B. Pomeroy, Charles E. Kimball, Archer N. Martin, S. C. Rowland, James H. Douglass and Hiram G. Dudley.

Baraga & Watersmeet.—The names of the incorporators of this Michigan company are as follows: Elias B. Sellers, Frank S. Armstrong, Joseph W. Alston, Edwin A. Armstrong, Albert F. Sellers, Enoch C. Bowling, Charles G. Pease, F. D. Tyler, C. A. Newcomb, H. L. Gabel, F. G. Skinner, all of Detroit, Mich., and Michael Flaherty, of Houghton county. The office of the corporation will be at Baraga, Mich.

Belt Line & Superior.—Charles D. Smith, Anthony Longua, Menzo G. Smith, all of Fond du Lac, Wis., and Orrin N. Carter, of Chicago, are the incorporators of this Wisconsin company.

Boston & Maine.—Louis C. Todd has been appointed Master Mechanic of the Passumpsic Division, with headquarters at Lyndonville, Vt., vice A. M. Stone, resigned.

Buffalo, Lackawanna & Pacific.—A meeting of the stockholders of the company was held at No. 22 West Seneca street, Buffalo, Feb. 28, and the following directors were elected: J. S. Smith, C. J. Pearson, J. D. Ripley, Joseph Richardson and J. H. Jenkins, of New York; J. O. Meyer, R. F. Goodman, E. H. Butler, M. B. Washburn, J. R. Smith, G. B. Mathews, Buffalo, N. Y., and C. B. Gaskill, of Niagara Falls. The directors elected the following officers: J. H. Jenkins, President; James R. Smith, Vice President; M. B. Washburn, Secretary; G. B. Mathews, Treasurer; J. E. McIntire, General Manager.

Camden & Atlantic.—The following Board of Directors was re-elected at the annual meeting in Camden, N. J., Feb. 26: George B. Roberts, William L. Elkin, Henry D. Welsh, Joseph N. Du Barry, Thomas H. Dudley, Richard D. Barclay, William C. Houston, William Bettle, Edmund E. Reed, Sr., William C. Dayton, Crawford Miller, Enoch A. Doughty and John B. Hay. The directors elected the following officers: President, George B. Roberts; Vice-President, William J. Sewell; Secretary, James R. McClure, and Treasurer, Robert W. Smith.

Charleston, Cincinnati & Chicago.—D. H. Chamberlain, of Charleston, S. C., Receiver of the South Carolina Railroad, has been appointed permanent Receiver of the entire line of this road situated in South Carolina, Virginia and North Carolina, relieving the temporary Receivers appointed in each of those states.

Charleston & Savannah.—A meeting of the stockholders of the company was held in Charleston, S. C., March 2, and the following Board of Directors was elected: H. B. Plant, New York; W. T. Walters and B. F. Newcomer, Baltimore; E. R. Memminger, W. H. Brawley and A. F. Ravanel, Charleston, and H. S. Haines, Savannah. The officers elected are: President, H. B. Plant; Vice-President, H. S. Haines; Secretary, R. B. Smith; Treasurer, T. M. Lee; Superintendent, C. L. Gadsden.

Chicago & Eastern Illinois.—William Campbell has been appointed Manager of the Southern Despatch Fast Freight Line, with office at 204 South Clark street, Chicago, vice W. D. Scott, resigned.

Chicago & Iowa.—A. Forsyth, Assistant Master Mechanic of the Chicago, Burlington & Quincy at Aurora, Ill., has also been appointed Master Mechanic of the Chicago & Iowa, with headquarters at Aurora, vice B. W. Morris, resigned.

Chicago & North Michigan.—The officers of this New Michigan company are as follows: President, Charles M. Heald; Vice-President, W. Alden Smith; Treasurer, F. H. Damon, of Boston; Secretary, Jas. Austin. These and N. B. Rogers, of Grand Rapids, and F. A. Nims, of Muskegon, are directors.

Choctaw Coal & Railway Co.—George Minch has been appointed Purchasing Agent for the company, with headquarters at 425 Commercial Building, St. Louis, Mo.

Cincinnati, Wabash & Michigan.—N. P. Ramsey has been appointed General Manager, vice Norman Beckley, appointed Treasurer. Heads of departments, except the Treasurer and Auditor, will report to the General Manager at Elkhart, Ind. The General Manager, Treasurer and Auditor will report to the Second Vice-President, Cincinnati, O.

Cleveland, Cincinnati, Chicago & St. Louis.—A. S. White, Assistant General Freight Agent, has been transferred from St. Louis to Cincinnati, where he will have charge of traffic on the Chicago division of the road. J. J. Fletcher, Assistant General Freight Agent at Cairo, has been transferred to St. Louis.

Dunkirk, Allegheny Valley & Pittsburgh.—George H. Daniels has been appointed General Passenger Agent of this company, in charge of passenger and baggage business, with office at Grand Central Station, New York.

Eastern Railroad Association.—Robert J. Fisher has been elected to fill the position of General Counsel of this Association vice Andrew McCallum, deceased. His official address will hereafter be No. 614 F street, Washington, D. C.

Elk River.—The incorporators are: William W. Weigbley, Philadelphia; A. H. Campbell, Charleston, W. Va.; Joseph Thomas, Brooklyn; William H. Wells and George E. Horne, New York.

Fort Scott, Arkansas & Texas.—The first Board of Directors are: C. W. Goodland, W. M. Rice, J. L. Stewart, J. R. Collin, Morris Liepman, W. C. Perry, D. B. Burger, all of Fort Scott, Kan.

Fort Scott, Kansas City & Northern.—The Directors chosen for the first year are: A. A. Harris, B. C. Garrison, John Crow, J. P. Chenault, A. W. Walburn, U. B. Pearsall, S. P. Mosher. The principal office of the company will be at Fort Scott, Kan.

Georgia.—Elwood S. Scheetz has recently been appointed Master Car Builder, with headquarters at Augusta, Ga., vice T. M. Preval, assigned to other duties.

Indian Springs & Flovilla.—W. F. Smith is the President of this company, G. B. Elder, Superintendent, and M. A. Lindsey, General Passenger Agent. The headquarters are at Flovilla, Ga. The line is 3¼ miles long, extending from Flovilla to Indian Springs.

Jersey City Belt.—The incorporators are: David G. Baird, Beverly, N. J.; John Hood, Camden; N. J.; Sydney Ward, Brooklyn; Thomas W. Holme, Burlington, N. J.; J. F. Shopperkotter, Philadelphia; Frank R. Baldwin, Jersey City, and A. L. Voorhis, Newark.

Kentucky Central.—W. J. Walsh has been appointed General Roadmaster, with headquarters at Paris, Ky.

Louisville & Nashville.—Colin A. Davies, Assistant Superintendent of the South and North Alabama Division, has been appointed Superintendent of the Louisville, Cincinnati & Lexington Division, with headquarters in Louisville. B. M. Starks, Trainmaster, succeeds Mr. Davies as Assistant Superintendent, with office at Birmingham, Ala.

Louisville Southern.—M. S. Sullivan, of Ludlow, Ky., has been appointed Master Mechanic, with headquarters at Harrodsburg, Ky. He was formerly connected with the Cincinnati Southern.

Mexican Pacific.—The following directors were elected at a recent meeting in Deming, N. Mex.: President, John W. Young, Salt Lake City, Utah; Vice-President, Tomas Macmanus, Chihuahua, Mex; General Counsel, T. F. Crosby, El Paso, Tex.; General Manager, W. Derby Johnson, Jr., Deming, N. Mex.; Chief Engineer, Ladislao Weber, Deming; Secretary and Right of Way Agent, William Crosby, El Paso; Representative at City of Mexico, Louis Haller.

New York, Pennsylvania & Ohio.—R. K. Pelton, formerly Contracting Agent at Cleveland, O., has been appointed Freight Agent of the Buffalo & Southwestern division, with headquarters at Buffalo, N. Y.

New York, Susquehanna & Western.—The annual meeting was held in Jersey City Feb. 26, and resulted in the choice of the following Directors: Simon Borg, Stephen V. White, Robert K. Dow, James M. Hartshorne, Joseph W. Ogden, Frank C. Lawrence, Jr., Alfred Sully, Charles Minzesheimer, Henry Sanford, John I. Blair, Garrett A. Hobart, George N. Farwell, John P. Rafferty. The only changes in the Board were the election of J. W. Ogden and J. P. Rafferty, the Second Vice-President and Secretary of the company, in place of Henry Marks and Charles Siedler. The total amount of stock voted was 66,654 shares of common and 60,216 shares of preferred. The Directors re-elected Simon Borg President.

Northern Central.—The directors were re-elected at the annual meeting in Baltimore, Feb. 26, as follows: George B. Roberts, Wister Morris, George Small, J. N. Hutchinson, B. F. Newcomer, John P. Green, Harry Walters, Henry James, J. N. DuBarry, Louis W. Hall, F. B. Parsons, J. D. Cameron. The board elected George B. Roberts President. Mr. Roberts then resigned as a director, and A. J. Cassatt was chosen to fill the vacancy. The following officials were elected: Frank Thomson, Vice-President; Stephen W. White, Secretary; J. S. Lieb, Treasurer.

Northern Pacific.—R. A. Eva has been made General Agent at Duluth, Minn., with supervision of freight business at the Lake Superior terminals except Ashland, and at local points west to Cloquet, Minn.

Nova Scotia Midland.—H. W. Leslie is the name of the General Manager of this company, M. Walton is Secretary, and the other offices are as given last week.

Paducah, Tennessee & Alabama.—C. M. Wead has been appointed General Freight and Passenger Agent of this company, with headquarters at Paducah, Ky.

Richmond & Danville.—M. C. Figg has been appointed Auditor of this company, vice C. M. Crump, resigned, taking effect March 1.

Seattle & Montana.—The following trustees were elected at a meeting in Seattle, Feb. 26: J. J. Hill and W. P. Clough, of St. Paul; E. O. Graves and D. H. Gilman, of Seattle. The Trustees elected J. J. Hill President and W. P. Clough, Vice-President.

Southern California.—W. A. McGovern has been appointed Superintendent of Telegraph, with headquarters at San Bernardino, Cal., vice Frank Darwin, resigned.

Terminal Railroad Association of St. Louis.—The annual meeting of the stockholders was held in St. Louis March 3, and the following Directors were elected: William Taussig, Chairman; John F. Barnard, S. H. H. Clark, George C. Smith, A. W. Dickinson, M. H. Smith, M. E. Ingalls, and Charles M. Hays.

Vermont & Canada.—The stockholders of this company met in St. Albans, Vt., March 2, and elected these directors: J. Gregory Smith, Jed P. Clark, E. C. Smith, W. G. Shaw, J. H. Perkins, D. D. Ranlett, J. M. Foss.

West Jersey.—At the annual election of the stockholders in Camden, N. J., March 3, the following Board of Directors was elected: George B. Roberts, Coleman F. Leaming, John M. Moore, Thomas H. Dudley, George Wood, J. N. DuBarry, N. Parker Shortridge, Henry D. Welsh, William J. Sewell, Benjamin F. Lee, James H. Nixon, Josiah Wistar, David B. Gill, B. B. Comegys and William G. Nixon. The Board organized by electing the following officers: President, George B. Roberts; Vice-President, W. J. Sewell; Secretary, James R. McClure; Treasurer, Robert W. Smith.

West Jersey & Atlantic.—The stockholders elected the following Directors at the annual meeting this week: George Wood, William J. Sewell, Aaron Fries, Mahlon Hutchinson, Samuel G. Lewis, Benjamin F. Lee, John M. Moore, William S. Scull, Walter Wood, Joseph N. DuBarry, Israel G. Adams, John J. Gardner and N. Parker Shortridge. The following officers were elected: President, George Wood; Vice-President, W. J. Sewell; Secretary, J. R. McClure; Treasurer, R. W. Smith.

RAILROAD CONSTRUCTION.
Incorporations, Surveys, Etc.

Atlanta & Chattahoochee.—The Secretary of State granted a charter to this company last week under the general law to build from Atlanta through Bolton and Hollywood to Roswell, a distance of about 35 miles. The capital stock is $250,000.

Barega & Watersmeet.—The route of this road, which was recently incorporated in Michigan, will be from Barega, southwest through the counties of Barega, Houghton, Ontonagon and Gogebic in the northern peninsula of Michigan to Watersmeet, connecting the Duluth, South Shore & Atlantic with the Chicago & Northwestern and Milwaukee, Lake Shore & Western. The line will be about 40 miles long and the surveys will probably be commenced early in the spring.

Bee Line & Superior.—The articles of incorporation of this company were filed in Wisconsin last week. The capital stock is $3,000,000. The proposed route is from Milwaukee to Superior, about 340 miles, passing through the counties of Milwaukee, Ozaukee, Washington, Sheboygan, Fond du Lac, Winnebago, Green Lake, Waushara, Waupaca, Portage, Lincoln, Marathon, Chippewa, Price, Sawyer, Bayfield, Ashland and Douglas.

Briarfield, Blockton & Birmingham.—The completion of the Bessemer branch of the East Tennessee, Virginia & Georgia has been several times delayed on account of obstructions in Gentry's Gap, north of Gurnee, Ala. But for the slides of earth and rock which have fallen and blocked the track the road would have been opened some months ago. The last track was laid Feb. 27, and it is not expected that the opening of the line will be delayed much more than a week. The branch extends from Gurnee north to Bessemer, Ala., near Birmingham.

British Columbia.—Among the many new companies seeking incorporation from the British Columbia government for the construction of railroads in that province are the following: Vancouver, Northern & Alaska, a line from Spence's Bridge into the Nicola Valley; Victoria & Beecher Bay, and the Chilliwack, the promoters of which are R. P. Cooke, George DeWolfe, Walter E. Graveley and others; D. Oppenheimer, H. Abbott and J. M. Browning ask for amendments to the Ashcroft & Cariboo Act of 1890; R. H. Alexander, Alexander Ewen, John Hendry, B. Douglas and C. D. Rand petition for

an act to authorize a line from a point on Burrard Inlet to the American boundary at Semiahmoo Bay, with a branch line to Chilliwack; F. C. Innes, E. E. Rand and John Campbell ask for an act to incorporate the Cernon & Okanagan Company; J. D. Pemberton asks for a charter for the Crow's Nest & Kootenay, which it is intended to build to the coast by way of Hope and New Westminster, the terminus being on Burrard Inlet.

Canadian Pacific.—A new survey is being made for an extension of the Southwestern branch from Melita, Man., the present end of track, west to the Souris coal fields in Manitoba. A preliminary survey for this line was made last year. The present survey is being run about six miles north of that line.

Cape Girardeau Southwestern.—Work is to commence on the extension of this road from Grandin, Mo., to Mammoth Spring, Ark., as soon as the weather will permit. The company is reported to have negotiated $800,000 of bonds, to provide funds for the extension.

Central Ontario.—Application has been made to the Ontario legislature for power to construct a branch from the line of this road in Marmara to connect with the Ontario & Quebec and the Grand Junction roads.

Charleston & Savannah.—The South Carolina Railroad Commission has examined four miles of the new branch, extending from Charles to Elliott, S. C., and authorized the company to open the road for public use.

Chesapeake & Ohio.—Gooch, Rinehardt, Carpenter & Co., of Louisville, Ky., have been awarded the contract to build the Warm Springs Valley Branch, between Healing Springs and Covington, Va. The line is 24 miles long, and is to be completed by the middle of June.

Chicago, Evansville & Chattanooga.—A joint meeting of the directors of the Chicago Henderson, Bowling Green & Chattanooga Railroad, and the Kentucky & Tennessee Construction Co., was held in Henderson, Ky., Feb. 23, locating the line between Henderson and Bowling Green. Engineer A. B. Fitch, of Terre Haute, made his report of the survey just completed by him, and that line was adopted. The route as now located, starting from Henderson, will cross Green River at Delaware, thence to Calhoun to the second crossing of Green River, three miles southeast of Cromwell, to Morgantown, and thence to Bowling Green. The distance from Henderson to Bowling Green is 100 miles.

Chicago, Indiana & Easton.—The company has been incorporated in Springfield, Ill., this week, and proposes to construct a road from a point on the line dividing Indiana and Illinois, in Cook county, northerly into the city of Chicago. The principal office is to be at Chicago. The road is to have an authorized capital stock of $5,000,000. The incorporators and first board of directors are: Hebert Thevis, N. P. R. Hatch, Thomas M. Whitehead, F. E. Bray and Charles Wheelwright, all of Chicago.

Chicago & North Michigan.—This company was organized at Grand Rapids, Mich., last week by officers of the Chicago & West Michigan to build the proposed extension of that line from Traverse City north to Charlevoix, Mich. The capital stock is $1,500,000. A construction company will be formed to build the line.

Chicago & Western Indiana.—The proposed issue of $1,000,000 additional bonds under the mortgage of Dec. 1, 1882, was formally authorized by the directors at a meeting in Chicago, Feb. 25. The money secured will be used in building additional second tracks and side tracks and in other improvements which have been described.

Cincinnati Southern.—The Harriman Land Co. has offered to build the bridge over the Emory River at Harriman, Tenn., and to transfer its control to this road if it will build a short line deflecting from its main line above Harriman and extending through the town to Emory Gap. It is stated that the company has accepted the proposition, and will abandon tunnel 27 on the present line when the new extension is built.

Columbia, Newberry & Laurens.—In a few days the section of the road between Newberry & Clinton, S. C., will be completed, and it will be opened for business as soon as it has been inspected by the railroad commission. The road has been completed from Columbia to Newberry, a distance of 43 miles, for some time, and over this section regular freight and passenger trains are being run. The section from Newberry to Clinton is 21 miles long. The first six miles of the track on the section to Jalapa was laid last year.

Elk River.—The charter of this company was filed in West Virginia last week. The proposed road will extend from Pleasant, Mason County, to a point on the Shenandoah River, near Charlestown, Jefferson County. The principal office is to be at Charleston, Kanawa County; the capital stock is $1,000,000.

Exeter & Amesbury.—The New Hampshire Legislature has passed the bill amending the charter of the company, authorizing it to extend its road. Under the amended charter the road may be constructed from a point on the Concord & Portsmouth in Epping or Raymond, through the intermediate towns to the state line in the towns of South Hampton or Seabrook. Assurances have been given that work will be commenced within a few months.

Fort Scott, Arkansas & Texas.—The company filed its charter in Kansas last week. It proposes to build a road from Fort Scott, Kan., to Galveston, Tex., passing through the following Kansas counties: Bourbon, Crawford and Cherokee. The estimated length is 700 miles.

Fort Scott, Chanute & Western.—The charter of the company was filed in Kansas last week. The company has been organized to build a road from Fort Scott to Guthrie, Oklahoma, through the following counties in Kansas: Bourbon, Allen, Neosho, Wilson, Montgomery, Elk, Chautauqua and Cowley. The estimated length of the line is 300 miles. The directors are: J. W. Davis, J. A. Bryant, J. D. Hill, C. F. Drake, W W. Bell, W. H. Clark and J. D. McCleverty, all of Fort Scott. The capital stock is $2,000,000.

Fort Scott, Kansas City & Northern.—The charter of the company provides for a line from Kansas City, Mo., through Fort Scott, Kan., to Fort Smith, Ark., a distance of 400 miles, passing through the counties of Linn, Bourbon, Crawford and Cherokee, in Kansas. The capital stock is $2,000,000.

Great Northern.—M. D. Wright, of Rathdrum, has been awarded the contract for clearing the right of way for 40 miles, extending from the crossing on Polk River to Albany Fall on the Pend d'Oreille River. Mr. Wright also has the contract to furnish 500,000 ties.

Foley Bros. & Guthrie, of St. Paul, who have the contract for the branch from Monarch, Mont., to the mines about Barker, state that they will have a force of men on the grading in a few days. The contract for the extension of the Neihart extensions is understood to be still unsettled, but it will doubtless be let in a few days.

Jersey City Belt.—This company was incorporated in New Jersey last week to build a road five or six miles long, from the Lehigh Valley freight station in Newark, N. J., along the Morris Canal, to a point on Newark Bay. The capital stock is $60,000, and it is thought that the line is proposed as a branch of the Lehigh Valley. The Morris Canal is owned by that company, and the state legislature has given it authority to abandon it as a waterway. The Shore Line Railroad was also incorporated at the same time to build a branch along Newark Bay.

La Salle & Bureau County Belt.—Surveys have been made during the past two weeks by Isham Randolph, of Chicago, for this proposed road from La Salle, Ill., west to a connection with the Chicago, Burlington & Quincy and the Chicago & Northwestern in the southern part of Bureau County. The line is about eight miles long, the belt about La Salle being two miles long. The work will be very light except about La Salle, where the present location will involve steep grades and sharp curvatures. The surveys are being made for the Matthieson & Hegeler Zinc Co., of La Salle, and if the road is built it will probably be through funds furnished by that company.

Little Falls & Dolgeville.—G. W. Edwards & Co., 52 Broadway, New York City, have been awarded the contract for building and equipping this road from Little Falls to Dolgeville, N. Y., about 12 miles.

Macon, Dublin & Savannah.—The subcontractors under the Illinois & Georgia Improvement Co. are progressing with the tracklaying east of Macon, Ga., quite rapidly, and have been laying three-quarters of a mile of track per day for some weeks past. The work has been completed through Jeffersonville, 22 miles, to which it was expected to have the line in operation by Feb. 1. It was also thought that the line would be ready for operation as far as Dublin, 53 miles east of Macon, by March 20, but it is not now likely that the trains will be running to that point before May.

Mexican Pacific.—The formal transfer of the franchises and other property of the Deming, Sierra Madre & Pacific and the Sonora, Sinaloa & Chihuahua was completed at a meeting of the directors of the two companies held in Deming, N. M., Feb. 19. The companies were consolidated and reorganized as the Mexican Pacific. It is expected that John W. Young, of Salt Lake City, who is the new owner of the franchises, will begin work immediately south of Deming, and repair the partly completed grade to the Mexican line and to Palomas, Mexico.

Midland (Indiana).—A press dispatch revives the report that work will soon begin on the proposed southern extension from Brazil. The proposed extension is said to be to Middleburg, 20 miles, and Linton, Ind., 40 miles, passing through Green and Sullivan counties and the southern part of Clay County.

Mohawk & St. Lawrence.—The company's officers expect to begin the grading at Rome, N. Y., within a few weeks if the weather continues fair. The contractors will work with a very large force, and when work is once begun the grading will undoubtedly be completed in a few months. Many of the contracts have been let. E. M. & J. M. Sullivan and Peter Rause, of New York, have the grading on the several sections. Westbrook & O'Brien, of New York, have the contract for the first 10 miles.

Montgomery, Hayneville & Camden.—The preliminary survey has been made for the 73 miles between Montgomery and Hayneville, Ala. The Chief Engineer, C. P. Rogers, in his report makes the following estimates of the cost of the work: For grading, at $2,184 per mile, $159,438; bridging and trestling, $81,353, making a total of $240,791, or $3,300 per mile, ready for tracklaying. The cost of tracklaying, cross ties and 50-lb. rails, $4,676 per mile, making $341,348, or $7,976 per mile, ready for cars. Side tracks and contingencies would increase it to $8,100 per mile.

Montreal & Western.—The second inspection of this road was made last week by Mr. Marcus Smith, C. E., for the Dominion government. The rails are now laid for 18 miles north of St. Jerome, Que., on the Canadian Pacific.

Nashua & Lowell.—In the United States Circuit Court at Boston, in the case of this company against the Boston & Lowell, judgment has been given for the former in $26,000. The controversy related to transactions growing out of the traffic contract between the two corporations.

Nashville & Cumberland Gap.—The engineers have been surveying for a final location from Cookeville, Tenn., east to Thorn Gap for the past two weeks, and it is expected that the contract will be let in a few days. Some surveying is still to be done on the more difficult part of the route.

New Brunswick.—Application is being made to the legislature for power to build a line from Weldford, on the Intercolonial, to a point near Grand Lake, in Queens County.

New Roads.—It is reported that a road will be built connecting the principal factories along the Straight River with the Cannon Valley Railroad at Faribault, Minn.

Patrick Rail, who has the contract to build the road from the station of the Austin & Northwestern in Austin, Tex., to the dam at the Colorado River which the town is constructing, has as yet only put a small force on the road, and is not making much progress in his work. The cut near the International & Great Northern tracks is only partially completed, because the bridge to be built by the latter railroad has not yet been erected.

At a meeting at Middletown, Md., in the interest of the proposed road from that point to connect with the Western Maryland, the people of Mechanicstown offered to extend the Monocacy Valley road to Yellow Springs, if the people of Middletown would build a line to that point. A committee was appointed to collect funds for a survey.

A member of the New York Assembly has introduced a bill appropriating $35,000 for the construction of a road two miles long, under the supervision of the Board of Managers of the New York State Reformatory at Elmira, from the grounds of the reformatory to connect with the railroads within the distance of two miles therefrom.

New York, Ontario & Western.—The tunnel through the mountains between North Walton and Franklin, N. Y., is rapidly nearing completion. The last blast was set off Feb. 14, and a large force of men is fast removing the small quantity of rock that remains in the tunnel. As soon as this work is finished, between 300 and 400 ft. of arch work of brick and stone will be put in and the tunnel will be ready for the passage of trains. The work was begun in May, 1889, and has been pushed with rapidity, and with scarcely an accident, and it is now believed the trains will be running through the tunnel May 20.

Northern Pacific.—Work has been resumed on the Seattle Belt Line, and probably construction will not be stopped until the line is finished. At Renton, Wash., the company has put in four crossings over the track of the Columbia & Puget Sound road. Tracklaying has been resumed north of the same track. The Howe truss bridge across Cedar River has been completed.

A party of surveyors are running a line, from the Seattle, Lake Shore & Eastern, along the south end of Lake Whatcom, thence along the east shore to Bellingham Bay, Wash., along a survey made a few years ago for an abandoned road. The surveyors are said to be engaged by this company.

A recent change in the survey of the Yakima & Pacific Coast road to South Bend, Wash., will make the distance between that place and Chehalis 56 miles. The force of graders, which has been small during the winter because of the wet weather, will be greatly increased as soon as the ground gets in a condition to allow work to proceed advantageously in the spring.

King & Dickinson, the contractors for the extension of the Green River & Northern branch, will also resume work between the end of track and Dunham, Wash., as soon as the weather becomes settled.

Ontario & Rainy River.—The surveying party has passed Penassie Lake, and is continuing westward. Thirteen miles of the line which was run from French Lake to Moss Township has been abandoned owing to the heavy work, and a new line located with fair grades. The party is surveying from one to three miles per day.

Philadelphia & Reading.—The survey for the proposed branch of the Catasauqua & Fogelsville to Nazareth, Pa., to connect with the Bangor & Portland, is reported in progress. It is thought that the line may be built during the summer. It will give the Reading a connection with the Delaware, Lackawanna & Pacific at Portland, through the Bangor & Portland.

Pittsburgh, Ohio Valley & Cincinnati.—That part of the line from Bellaire, O., where the connection is made with the Cleveland & Pittsburg, along the Ohio River to Powhatan, was contracted for last year, but only about three miles of track was laid. A good deal of grading was done on the 16 miles under contract, and that section will probably be ready for operation early in the summer. The line south and west of Powhatan, through Matamoras to Marietta, O., is now being relocated, and the lines changed in some places. The contract will probably be let this year for most of the 40 miles between these points, but it has not yet been decided when to begin the work. The maximum grade on the whole line will be 21 ft., and the maximum curves three degrees. Part of the work on the extension will be quite heavy.

Port Townsend Southern.—The Oregon Improvement Co. has let the contract to J. H. Smith to complete the eight-mile extension of this road from the present end of the line at Hookers Lake to Quilcene, Wash., the northern terminus of Hoods Canal. The contract requires Mr. Smith to have the line completed, ready for operation, June 15. The contractor has made all arrangements for men and teams to begin work. It is said the company will expend about $20,000 in ballasting the road. The company will probably soon resume work on the extension from north of Olympia to the southern end of Hoods Canal.

Ravenswood, Spencer & Glenville.—The track has been laid on 8½ miles of this West Virginia road up to the present time, and the contractors are pushing the construction work as rapidly as possible. Two miles of the track was laid last month. The line is under contract from Ravenswood, on the Ohio River, to Spencer, W. Va., a distance of 33 miles. The road follows Sand Creek to Leroy, and extends westerly through Reedy to Spencer. It crosses a number of creeks and rivers, some of which will require large bridges. Stanley & Olds, of Ravenswood, the contractors for the grading, have about completed that part of the work. A. S. Kerr, of Ravenswood, has the contract for all the timber work. The line is an extension of the Ohio River road and connects with it at Ravenswood.

Red River & Southwestern.—J. M. Preston is reported to be running a preliminary survey for this road from a point near Henrietta, Tex., east to the Red River, and thence southwest to Archer City. As soon as the line is located to Archer City the contract will be let at once from Red River to Archer City. The surveying party will run a line from Archer City southwest through Throckmorton, Shackelford, Jones and Taylor counties to Abilene, and from Abilene to Ballinger or San Angelo, in Tom Green County.

Reynoldsville & Falls Creek.—The road is to be extended during the coming summer from Reynoldsville to a point near Punxsutawney or Adrian, Pa., where it will connect with the Pennsylvania & Northwestern and to near the Pleasant Valley mines. The extension will open a very productive coal region.

St. Paul, New Ulm & Southwestern.—The company has executed a trust deed to the American Loan & Trust Co., of New York, for $17,000 per mile for each ten miles completed, less $10,700 in case certain provisions are carried out.

Savannah, Americus & Montgomery.—The number of men reported to be at work under the contractors on the Montgomery extension is given as 1,000, and 500 teams are also employed. This force is mostly west of Hurtsboro, Ala. The piers of the steel bridge across the Chattahoochee River west of Louvale are nearly completed and several hundred men are engaged on the sub-structure work. It will be ready for the superstructure very soon. The iron work has been completed at the bridge works and it is not likely that there will be any delay from that part of the work. As soon as the bridge is erected the track will be laid across and through Hurtsboro. It is expected to reach Montgomery early in July.

Seattle, Lake Shore & Eastern.—The contractors on the extension of the Northern branch have about finished a mile of work on which there were five trestles, the longest being 270 ft. The tracklayers will probably reach Nooksack City, Wash., this week. The town is six miles south of the International Boundary, and the

connection with the Canadian Pacific branch will be made about the middle of the month.

Silver Creek & Dunkirk.—The contract for building this road between Dunkirk and Silver Creek, N. Y., has been let to the Drake & Stratton Co., 71 Broadway, New York. The contractors have had a force of men on the work for the last few days, but they propose to increase the number in a few weeks. The road is being built as a low grade cut-off for the Lake Shore & Michigan Southern between Silver Creek and Dunkirk, and its construction is necessary in carrying out the plan to make a maximum grade of 16 ft. between Chicago and Buffalo. The length of the line is about nine miles. There are several bridges, but they will probably be built entirely of masonry.

South Bound.—The location will very probably be finished by March 15. Only 15 miles remains to be surveyed. The route from Savannah to Columbia, S. C., is about 150 miles long, and passes through the towns of Stokes Bluff, Lawtonville, Campbellton, Bufords Bridge and Grahams, all in South Carolina. The road is being built by the Savannah Construction Co., which has sublet contracts for part of the work to Holshausen & Schiltz, and Moore & Springs, Columbia, S. C.; J. E. Moore & Co., Graham, S. C.; S. R. Adams & Co., J. A. Newcomber & Co., Hartinett & O'Brien and J. M. Willis, Brunson, S. C. The contractors have 500 men and nearly as many teams on the work, and have already graded about 50 miles of the road. The track has been laid for 15 miles, of which seven miles has been laid this year. The entire road will probably be completed by next October. The maximum grade is 52.8 ft. per mile, and the maximum curves, 5½ degrees. The longest trestles are the Savannah River, three miles long; Coosawhatchie Swamps, at Salkehatchie, 5,000 ft.; South and North Edisto Rivers, 4,000 ft. each, and at Caugaree Creek, 3,000 ft. Two other trestles will be 1,500 ft. and 1,700 ft. long each.

Toronto, Sudbury & Pacific.—This company is applying to the Dominion Parliament for power to construct a road from a point near Toronto to Sudbury, in the district of Nipissing, Ont.

GENERAL RAILROAD NEWS.

Chicago, Milwaukee & St. Paul.—The following statement gives the earnings for January:

January.	1891.	1890.	Inc. or dec.
Gross earn.	$1,946,196	$1,794,411	I. $151,784
Oper. expen. and taxes.	1,427,280	1,341,167	I. 86,113
Net earn.	$518,915	$453,244	I. $65,671
Seven months to Jan. 31:			
Earnings.	$17,142,616	$16,585,711	I. $556,905
Expen. and taxes.	10,993,801	10,211,813	I. 781,987
Net earn.	$6,148,815	$6,373,897	D. $225,082

Cleveland & Canton.—The stockholders and directors have voted to issue a new series of five per cent. car trust debenture bonds, and the officers have been authorized to issue as many as they deem necessary. The amount authorized is $2,000,000. The bonds are a first lien on rolling stock and a second mortgage on other property. About $600,000 will be issued this year, $200,000 to take up outstanding equipment liens and maturing car trust payments, and the balance to be applied to the purchase of 3,000 coal cars, 100 stone cars, 100 coke cars and five locomotives. Those issued the present year will increase the company's debt $400,000, the additional $200,000 taking the place of outstanding debt. The bonds sold this year will add $20,000 to the interest charges.

Concord.—Austin Corbin has written the following letter to the Governor of New Hampshire: Several years ago I and my associates offered the state of New Hampshire $500,000 for its interest in the Concord Railroad. Changed conditions induce me now to enlarge the offer. I will give $1,000,000 for possession under an act of the Legislature substantially as follows: The act shall (1) sell and convey to me and my associates, to be named hereafter, all the state's right in the Concord road and its appurtenances, with the privilege of organizing the purchasers as a corporation for operating the road, and shall secure to the new corporation, by proper legislation, the same rights and privileges now held by the stockholders of the present corporation. The act shall (2) confer upon the Supreme Court jurisdiction to transfer to the purchasers all properties now owned by the corporation, and possession of the same, and possession of the road and its equipment, upon payment to the stockholders of $1,000,000, and of all arrears of 10 per cent. dividends, without interest on such arrears. If the state prefers not to receive its $1,000,000 in one sum, it may be arranged to be paid in installments of $200,000 with interest, or the installments may be without interest and the principal sum correspondingly increased above $1,000,000. The matter was referred to the Judiciary Committee.

Coshocton & Northern.—A deed transferring the road to the Cleveland, Canton & Southern, in accordance with the action of the stockholders at Coshocton, O., Feb. 24, was filed for record this week. Under the agreement the purchaser assumes $600,000 bonds and issues second preferred stock to stockholders.

Escanaba, Iron Mountain & Western.—The report that the sale of this road was to persons acting in the interest of the Chicago & Northwestern is denied. The road has been sold by the Schlesingers, together with a half interest in the mines in Michigan and the lake steamer line owned by them, but the Chicago & North western has not become interested in any of the companies.

Illinois Central.—The net income from traffic for the seven months ending Jan. 31, 1891 and 1890 (January, 1891, estimated), was as follows:

	1891.	1890.	Inc. or Dec.
Miles operated.	2,875	2,875	
Gross earnings.	$10,726,827	$10,211,567	I. $515,260
Oper. expen. and taxes.	7,315,776	6,238,556	I. 1,077,220
Net earnings.	3,411,051	3,973,011	D. 561,960

The earnings of the Dubuque & Sioux City are included in the above statement.

Kentucky Union.—J. Kennedy Tod & Co., of New York, this week obtained a judgment in Louisville, Ky., against the railroad company and the Kentucky Land Co. for $390,000. The suit is a part of the financial trouble which put the Kentucky Union into the hands of a receiver.

Louisville & Nashville.—The company offered this week in New York and in Europe five million dollars of the new 50-year four per cent. bonds at 85 and interest. The bonds are part of the consolidated issue, which is limited to $75,000,000, and secured by a mortgage on the entire main line. The bonds are also secured by a majority of the securities of the roads which the Louisville & Nashville controls through stock ownership, and by a deposit of $23,898,000 in bonds.

The company reports gross earnings for January of $1,590,515, an increase of $19,188 as compared with the same month of last year, and net earnings of $585,359, a decrease of $27,964. For the seven months ended Jan. 31 the gross earnings were $11,624,890, an increase of $334,496 as compared with the corresponding period of last year, and net earnings $4,379,628, a decrease of $289,315.

Maine Shore Line.—Colonel Greene, the projector of this scheme, has asked the Maine Legislature to pass a bill, giving Washington County authority to guarantee for 30 years 5 per cent. interest on $650,000 bonds of the road. The bill also provides that the bonded indebtedness shall not exceed $2,000,000; that the net income of the road be first expended in meeting the interest on bonds not guaranteed by the county, and that the road be exempt from taxation for 20 years.

New York, Lake Erie & Western.—The earnings and expenses for January, 1891, and the four months from Oct. 1, as compared with the same period of last year, are given in the following table:

January.	1891.	1890.	Inc. or Dec.
Gross earnings.	$2,172,279	$2,155,785	I. $16,494
Oper. expenses.	1,595,027	1,543,316	I. 51,711
	$577,252	$612,469	D. $35,217
Less proportions due leased lines.	189,451	189,643	D. 192
Net earnings.	$387,801	$422,826	D. $35,025
Oct. 1 to Jan. 31.			
Gross earnings.	$9,777,096	$9,627,819	I. $149,257
Oper. expenses.	6,631,968	6,379,900	I. 252,058
	$3,145,108	$3,247,900	D. $102,801
Less proportions due leased lines.	889,590	885,031	I. 4,559
Net earnings.	$2,255,518	$2,362,878	D. $107,360

New York & New England.—The transfer of the Woonsocket & Pascoag road to the New York & New England has been completed, that company having taken possession March 2. Regular trains will begin running next week between Woonsocket and Harrisville, R. I., 10 miles.

New York, Susquehanna & Western.—The gross earnings of the road in 1890 were $1,592,083; operating expenses, $890,964; net earnings from traffic, $701,114; income from other sources, $30,401; total, $731,516; surplus after all charges, $203,664. Expenditures for equipment and improvement, $130,760; charges to operation, $61,367; for second track and for equipment, $218,888; coal tonnage shows an increase of 194,761 tons. The net increase of earnings over 1889 was $117,541. The company has authorized the issue of $3,000,000 general mortgage five per cent. 50-year gold bonds, dated Aug. 1, 1890. The proceeds of these bonds will be applied as follows: $1,000,000 to retire outstanding seconds, $1,000,000 for future acquirements of property and equipment, and $1,000,000 to be held by the company.

Norfolk, Albemarle & Atlantic.—The stockholders of the Norfolk & Virginia Beach, at a meeting held in Norfolk, Va., March 2, voted to consolidate with the Danville & Seaboard. The provisions of the charter of the latter company are more general and liberal than those of the Virginia Beach Co. The title of the reorganized company will be the Norfolk, Albemarle & Atlantic, as already explained. A meeting of the directors of the new company will be soon held to consider the plan of an extension from a point above Jackson's Station to Pungo Ferry, on the Albemarle Sound, a distance of about 25 miles from Norfolk.

Northern Pacific.—The following table gives the earnings of this road and the Wisconsin Central for January:

Northern Pacific:	1891.	1890.	Inc.
Gross earn.	$1,752,139	$1,177,400	$574,739
Oper. expenses.	1,150,189	894,168	256,021
Net earn.	$601,950	$283,232	$318,718
Wisconsin Central:			
Gross earn.	$371,719	$325,578	$45,141
Oper expen.	265,980	245,913	20,067
Net earn.	$105,739	$79,665	$26,074

The result for both roads for the month was: Gross earnings, $2,123,859; operating expenses, $1,416,170; net, $707,689; other income, $71,138; total income, $778,827; charges, $985,557; deficit, $206,730. The amount of preferred stock cancelled in January was $110,226, leaving $36,799,627 outstanding. Funded debt outstanding, $120,175,500, of which $37,428,000 are the new consol 5s.

The gross earnings of the two roads from July 1 to Jan. 31 were:

	1891.	1890.	Inc.
Northern Pacific.	$16,199,753	$13,832,762	$2,366,991
Wisconsin Central.	3,290,784	2,811,020	479,764
Both roads.	$19,490,537	$16,643,782	$2,846,755

The decision of the United States Supreme Court in the suit of the St. Paul, Minneapolis & Manitoba over a large tract of land in Northern Minnesota, giving judgment for the Northern Pacific, was announced this week. The land was claimed by the Manitoba as part of its land grant, and the suits have been carried on since 1873, when the question was before the Commissioner of the Land Grant Office. James McNaught, General Counsel, speaking of the effect of the decision, says that "under the plan of reorganization made in 1875 by the Northern Pacific, all of the lands east of the Missouri River within the limits of the company's grants were to be applied to the retirement of the preferred stock. The 500,000 acres of land recently in dispute are all east of the Missouri River and are all in the state of Minnesota. The money now in the hands of the special Land Commissioner will be applied to the retirement of the preferred stock, as will be the proceeds of the lands hereafter sold. The amount realized by sales by the Special Commissioner up to June 30, 1890, is $1,442,046. At that date there was invested in government bonds by the Commissioner $1,005,000, there was $207,070 represented by deferred payments on lands sold, and the amount of money in the hands of the Commissioner was $8,748. The average price at which the land was sold up to June 30 last was $6.31 per acre." The Commissioner had sold 210,900 acres up to June 30, leaving 289,100 acres, to be sold, which, if they realize $6.31 an acre, will bring $1,824,221, so that the total value to the company will be about $3,135,000, which must be used to retire the preferred stock.

Oregon Improvement Co.—The receivers appointed in Oregon and in New York in the proceedings brought by the Farmers' Loan & Trust Co., last December, were discharged last week by the United States Circuit Courts in New York and Portland, Or. The company's solvency has been re-established, and it announces that the interest due on the first mortgage bonds last December will be payable after March 1. Since the road went into the receivers' hands a new issue of bonds to the amount of $4,000,000 has been sold, which realized about $2,500,000. This has been sufficient to pay the floating indebtedness and the other pressing accounts.

Oregon & Washington Territory.—It was announced this week that Charles B. Wright, of Philadelphia, has purchased from George W. Huut, of Walla Walla, Wash., the railroads known as the "Hunt system," which penetrate the wheat fields of Eastern Washington and Oregon south of the Columbia River. The first payment on this transaction, which involves $3,000,000, was made. There has been a long contest for these properties, first between the Oregon Railway & Navigation Co. and the Northern Pacific, and later between the Great Northern and Mr. Wright. The lines extend from Walla Walla Junction, on the Northern Pacific, south and southwest to Pendleton and Centreville, 55 miles, and southeast to Walla Walla and Riparia, on the Snake River, 111 miles. There are under construction some 42 miles of road to other important points in the Walla Walla Valley which will be built by Mr. Hunt and turned over to Mr. Wright this year.

Pemberton & Hightstown.—The officers of the Union Transportation Co. are negotiating for a renewal of the lease of this road. It was formerly run at a loss of from $15,000 to $20,000 per annum, but under the present management, composed of farmers living along the line of the road, it has more than paid its way. It has been operated by the Union Transportation Co. since August, 1888, when the Pennsylvania surrendered its lease.

Philadelphia & Reading.—The company reports the earnings for January in detail as follows:

	1891.	1890.	Inc. or dec.
Gross earn.	$1,712,000	$1,566,730	I. $145,369
Oper. expen.	983,115	962,973	I. 20,142
Net earn.	$728,975	$603,757	I. $125,218
Other income.	84,366	75,371	I. 8,995
Total net earn.	$813,341	$679,128	I. $134,213
Charges and improv.	665,797	724,897	D. 59,100
Balance.	$147,544	$45,769	I. $193,313

The earnings of the Coal & Iron Co. were:

Gross earn.	$1,443,760	$1,151,255	I. $292,504
Oper. expen.	1,239,515	1,118,752	I. 220,763
Net earn.	$104,245	$32,503	I. $71,741
Colliery imp.	93,426	65,671	I. 27,754
Balance.	$10,819	$33,168	I. $43,987
Charges	68,000	68,510	D. 510
Deficit.	$57,181	$101,678	D. $44,497

The earnings of both companies since Dec. 1 were:

Gross earn.	$6,448,338	$5,747,524	I. $700,814
Oper. expen.	4,905,601	4,474,249	I. 431,352
Net earn.	$1,542,737	$1,273,276	I. $269,462

Richmond & Danville.—That portion of the railroad belonging to the Virginia Midland Railway Company extending from Orange to Gordonsville, Va., and known as the Gordonsville Branch, having been leased to the Chesapeake & Ohio from March 1, the service of the Richmond & Danville will be withdrawn from the branch line after that date, and its operation conducted by the Chesapeake & Ohio, lessee.

St. Louis, Iron Mountain & Southern.—The company has notified the first mortgage bondholders of the Cairo & Fulton road that their bonds will be paid off with accrued interest to Feb. 24 at the office of the Mercantile Trust Co., in New York, when presented. The amount outstanding is about $5,700,000, and with the retirement of this issue the Iron Mountain five per cents become a first mortgage on about 300 miles of road in Arkansas, on which they are now only a second mortgage.

Union Pacific.—The report of earnings and expenses for December and the year to Dec. 31, in detail, is as follows:

OREGON SHORT LINE & UTAH NORTHERN.

Month of December:	1891.	1890.	Inc. or Dec.
Mileage.	1,422	1,399	I. 23
Gross earn.	$649,259	$553,406	I. $95,853
Oper. expen.	430,371	410,019	I. 20,352
Net earn.	$218,888	$143,387	I. $75,501
Year to Dec. 31:			
Gross earn.	$7,488,031	$6,512,345	D. $975,686
Oper. expen.	4,965,720	3,700,864	I. 1,264,866
Net earn.	$2,522,301	$2,811,481	D. $289,180

OREGON & NAVIGATION.
(Rail lines.)

December:			
Mileage.	1,020	985	I. 14
Gross earn.	$512,780	$357,677	I. $155,103
Oper. expen.	343,557	285,449	I. 58,108
Net earn.	$169,223	$72,228	I. $96,995
Year to Dec. 31:			
Gross earn.	$4,954,711	$4,576,136	I. $378,575
Oper. expen.	3,936,025	2,883,797	I. 1,052,228
Net earn.	$1,018,686	$1,692,339	D. $673,653

UNION PACIFIC, DENVER & GULF.

December.			
Mileage.	1,414	1,385	I. 29
Gross earn.	$484,180	$431,589	I. $52,591
Oper. expen.	349,873	333,270	I. 16,603
Net earn.	133,307	$98,319	I. $35,988
Year.			
Gross earn.	$5,783,126	$4,595,095	I. $1,188,041
Oper. expen.	4,007,083	3,432,947	I. 574,136
Net earn.	$1,776,053	$1,162,148	I. $613,905

TOTAL FOR ALL DIVISIONS.

December.			
Mileage.	8,075	7,971	I. 104
Gross earn.	$3,549,175	$3,713,203	I. $164,028
Oper. expen.	2,781,378	2,652,513	I. 128,864
Net earn.	$767,797	$1,060,690	D. $292,893
Year.			
Gross earn.	$44,338,201	$40,941,063	D. $3,397,138
Oper. expen.	30,635,927	25,620,565	I. 5,015,362
Net earn.	$12,902,274	$15,320,498	D. $1,418,224

TRAFFIC.

Chicago Traffic Matters.

CHICAGO, March 4, 1891.

The Western Passenger Association having acted favorably upon the application for membership of the Jacksonville Southeastern, the principal disturbing element in the Southwestern passenger situation is removed. If the lines in the Association succeed in adopting an ironclad form of round-trip ticket which will defy the ticket brokers they may expect a continued period of well-maintained rates.

Many of the Chicago lines are obliged to face a serious deficit in their January and February net earnings caused by the present light movement of traffic. As a consequence reductions in the operating force are being energetically enforced.

The Chicago Committee of the Central Traffic Association announces rates on live stock and dressed beef between Chicago and New York and Boston and New England points, effective March 9, as follows: Dressed beef to New York, 45 cents; Boston, 46½ cents by direct lines, and 45 by lines north of Lake Ontario; cattle to Boston and New York, 26 cents; sheep and hogs, 30 cents; horses and mules, 60 cents. The Canadian lines thus get a differential of 1½ cents, and they are allowed to pay 1 cent a mile on refrigerator cars.

The Board of Apportionment controlling the Southwestern traffic under the agreement of July 30, 1890, will hold a meeting Friday, March 6, at which time it is expected that a solution of the misunderstanding in connection with the Atchison's diversions will be arrived at.

Figures are published showing comparative gross freight earnings of the Southwestern Missouri River lines for the month of January as follows: Chicago & Alton, $74,366, against $106,184 for the same month in 1890; Rock Island, $45,857, against $88,060; Wabash, $48,814, against $110,928; Missouri Pacific, $63,260, against $75,864; St. Paul, $43,409, against $102,789; Atchison, $94,348, against $160,179; Chicago, St. Paul & Kansas City, $13,263, against $62,346; Kansas City, Fort Scott & Memphis, $40,065, against $52,421; Burlington, $92,466, against $94,730.

Figures are published giving the percentage of Northwestern passenger traffic, which it is proposed to divide by agreement. They are as follows for the three months ending Jan. 31: St. Paul, 27 per cent.; Wisconsin Central, 22; Northwestern, 17; Kansas City, 15; Burlington & Northern, 11, and Albert Lea 8. No order for division of business has been issued.

Allegations of rate cutting on freight to the Atlantic seaboard continue as plenty as ever. A prominent traffic official claims that a larger portion of last week's traffic was taken at cut rates than of any week since the Interstate Commerce law went into effect. Of the flour, grain and provisions sent through to the seaboard the Grand Trunk took 25 per cent., against 13 per cent. last year; Nickel Plate, 19, against 9 last year; Michigan Central, 18, each year; Lake Shore, 14, against 24 last year; Baltimore & Ohio, 11, against 8; Fort Wayne, 8, against 14, and Pan Handle 4, against 14.

Traffic Notes.

A manufacturing concern at Logan, Utah, lately hauled a large shipment of freight from Ogden, about 40 miles, by ox teams at an expense of 40 cents per 100 lbs., for the reason, it is alleged, that the Union Pacific increased its tariff from 22 to 59 cents per 100 lbs.

It is stated in the Cleveland *Leader* that the 1,000-mile tickets issued by certain Ohio roads, and accepted for passage on a number of other roads, are hurting the passenger traffic on the lines which refused to enter the agreement and that the latter are complaining loudly. They threaten to issue 500-mile tickets at two cents a mile.

The Georgia Railroad Commission has called on the Central of Georgia to explain why it disregards the Commission's order directing that joint freight rates must not be more than 90 per cent. of the combined local rates. This order was issued last October. It is said that the East Tennessee, Virginia & Georgia has also disregarded it.

There have all along been complaints that the Trunk Line-Central traffic anti-ticket-commission agreement was a dead letter, and these criticisms are now growing louder and more numerous. Roads west of Chicago are said to tell Eastern agents to keep quiet a couple of months, and then all back commissions will be paid. The emigrant business out of New York is said to be controlled by the outside agents as thoroughly as ever. The Niagara Falls short line is accused of paying commissions at Kansas City.

The Supreme Court of the United States this week affirmed the judgment of the lower court in the case of the Covington Stock Yards Co. against Keith & Wilson. This firm shipped cattle over the Kentucky Central road, which company would deliver cattle only at the stock yards of the plaintiff, charging an extra fee therefor. The court holds that this charge is unlawful, and that the road when it contracted to transport cattle undertook to receive and deliver them, and that it had no more right to make a special charge for this service than for the use of its station by passengers whom it transported. Opinion by Justice Harlan.

Kansas City Freight Association.

The general agents of the railroads centering at Kansas City have formed the Kansas City Freight Association. It is composed of one representative of the freight department of each road.

East-bound Shipments.

The shipments of east-bound freight from Chicago by all the lines for the week ending Saturday, Feb. 28, amounted to 76,702 tons, against 78,681 tons during the preceding week, a decrease of 1,979 tons. The proportions carried by each road were:

	Wk. to Feb. 28.		Wk. to Feb. 21.	
	Tons.	P. C.	Tons.	P. C.
Michigan Central	10,435	13.6	12,106	15.4
Wabash	4,198	5.5	4,010	5.1
Lake Shore & Michigan South.	11,454	14.9	12,818	16.4
Pitts., Ft. Wayne & Chicago	6,149	8.0	7,416	9.3
Chicago, St. Louis & Pitts	8,631	11.3	10,091	12.9
Baltimore & Ohio	6,011	7.8	4,549	5.8
Chicago & Grand Trunk	11,938	15.6	11,562	14.7
New York, Chic. & St. Louis	9,493	12.4	8,906	11.4
Chicago & Atlantic	8,393	10.9	7,193	9.0
Total	76,702	100.0	78,687	100.0

Of the above shipments 4,807 tons were flour, 39,465 tons grain, 2,985 tons millstuffs, 5,577 tons cured meats, 3,100 tons lard, 7,689 tons dressed beef, 1,081 tons hides, and 5,976 tons lumber. The three Vanderbilt lines carried together 40.9 per cent., while the two Pennsylvania lines carried but 19.3 per cent.

Annual Report, Pennsylvania Railroad.

MAIN LINE AND BRANCHES, PHILADELPHIA TO PITTSBURGH.

Earnings	$40,043,670
Expenses	25,894,106
Net earnings	$14,149,564
Add interest from investments (in cash), also for use of equipment and from other items	5,365,730
Total	$19,515,294
Deduct rentals paid branch roads, interest on equipment, interest on bonded debt, state tax on dividends, and other items	8,484,893
Net income Pennsylvania Railroad Division	$11,030,401

PHILADELPHIA TO NEW YORK AND BRANCHES.

Earnings	$18,938,897
Expenses	14,283,078
Net earnings from operating	$4,655,818
Add interest from investments and rents	479,157
Total income	$5,134,976
Deduct payments on account of dividends, interest on equipment, etc	4,738,091
Net profit under the lease of United New Jersey Railroad & Canal Company's property	396,885
Total	$11,427,286

PHILADELPHIA & ERIE RAILROAD.

Earnings	$7,219,692
Expenses	4,803,370
Net earnings	$2,416,322
Deduct payments on account of rentals and interest charged for use of equipment	2,417,966
Loss on Philadelphia & Erie Railroad Division, including branches operated in connection therewith	$1,644
Balance	$11,425,642
From this balance of income for the year the following amounts have been deducted, viz:	
Payment to the fund for the purchase of securities guaranteed by the Pennsylvania Railroad Company	$93,498
Pennsylvania Railroad Company's consolidated mortgage bonds, sinking fund account	324,800

ALLEGHENY VALLEY RAILROAD COMPANY.

Payments on account of guaranty of principal and interest of bonds	119,005

EXTRAORDINARY REPAIRS.

Amount expended in straightening and revising lines and grades, and for other purposes not properly chargeable to capital account	1,632,024
	$2,169,327
Balance	9,256,314
Out of which was paid a dividend of 5½ per cent	6,241,873
Amount transferred to credit of profit and loss for the year 1890	$3,014,441
From which deduct extraordinary expenditures, debited to profit and loss on account of floods, June, 1889, and in settlement of sundry accounts	1,064,704
	$1,949,737
Add amount to credit of profit and loss Dec. 31, 1889	20,068,055
Balance to credit of profit and loss Dec. 31, 1890	$22,017,793

The foregoing statements show a net income of $11,425,642. After deducting from this sum the amounts properly chargeable thereto, there is a balance for the year of $9,256,314, out of which there was paid a dividend of five and one-half per cent., being an increase in the amount of cash distributed to the shareholders of $914,603, as compared with the year 1889. All the repairs made necessary by the flood of 1889 have been completed.

The cost of the securities of other corporations now held by your company is $113,183,734, and the direct revenue received therefrom was $4,439,403, which is in excess of the interest on your funded debt.

The Pennsylvania system is now composed of 120 corporations, which, with few exceptions, are in good financial condition, and earning fair returns on the capital invested. These corporations represent 7,915 miles of railroad and canal, with a share and bonded capital of over $700,000,000, which, in 1890, earned more than $133,000,000 gross and moved over 137,000,000 tons of freight and 81,000,000 passengers.

There has been a very large increase in the amount of traffic moved, as compared with 1889, without a corresponding increase in the net revenue therefrom, a result attributable directly to the reduced rates prevailing during the year.

The criticism has been made that, while there has been a very large reduction in the freight rates in the past decade, there has not been a corresponding reduction in passenger rates. Although the reduction in freight charges has been apparently much greater than in passenger rates, yet the demands of the public for increased service, higher speed, and the comforts of parlor, sleeping and dining cars have more than counterbalanced this apparent difference, while the cost of these additional facilities, together with the expense attendant upon the interlocking and block systems and other appliances for increased safety, has precluded the possibility of making greater reductions in the passenger rates without rendering the entire traffic unprofitable. This is shown clearly by the fact, that while the cost of moving freight per ton per mile on your Main Line has been reduced in the past 20 years from 9⅛ to about 4 mills, the cost per passenger per mile has only been reduced from 19⅞ to 16 mills.

The New Jersey Division shows an increased surplus of net revenue after meeting the obligations connected therewith. During the past year large expenditures have been made in the improvement of this property; notably in elevating its tracks in the city of Philadelphia to avoid street crossings at grade, in preparing for the fourth track through Trenton, and in securing additional right of way at various points. The largest expenditure, however, has been in the work of elevating and rebuilding the tracks and passenger station in Jersey City, in the construction of train-sheds at that point, and of a new roundhouse and yard facilities convenient thereto. The principal portion of this work will be completed during the current year.

There has been expended for construction, equipment and real estate as follows:

Pennsylvania Railroad and branches	$3,656,576
United railroads of New Jersey	1,054,844
Philadelphia & Trenton Railroad	82,299
*And for improvements and extensions on branch and auxiliary lines operated by the company	5,717,907
Total	$10,511,627
On account of these advances, there has been received from those companies, in cash	941,622
Total amount expended on capital account in 1890	$9,570,005

*On account of these advances to branch and auxiliary lines there have been received in securities of those companies $2,1-150.

SUMMARY OF LINES OWNED OR CONTROLLED EAST AND WEST OF PITTSBURGH.

	1890.	1889.	Inc.
Gross earn. from traffic.	$135,521,622	$122,917,337	$10,604,285
Gross expen., including rentals, interest, dividends, etc	92,603,361	83,811,127	8,192,236
Showing net earn	$41,518,257	$39,106,209	$2,412,048

FREIGHT TRAFFIC.

	1890. Number of Tons.	1890. Number of Tons one mile.	1889. Number of Tons	1889. Number of Tons one mile.
Lines east of Pittsburgh and Erie	92,884,362	8,521,694,739	82,240,457	7,621,926,314
Lines west of Pittsburgh	44,532,623	4,131,799,228	39,923,661	3,652,238,746
Totals	137,416,985	12,643,493,967	122,164,118	11,274,165,060

PASSENGER TRAFFIC.

	1890. Number of Passengers.	1890. Number of Passengers one mile.	1889. Number of Passengers.	1889. Number of Passengers one mile.
Lines east of Pittsburgh and Erie	66,199,752	1,171,328,701	61,857,729	1,110,971,446
Lines west of Pittsburgh	17,912,708	428,205,644	16,269,228	405,726,898
Totals	84,112,460	1,599,534,345	78,126,957	1,516,698,344

GENERAL REMARKS.

There was contributed to the Employés' Relief Fund by your company and affiliated lines during the year $69,838.01, for operating expenses, and in addition thereto the sum of $16,673 for extra benefits to members of the fund whose disability had continued over 52 weeks. The amount contributed by the employés was $440,103.83. There was paid to the families of employés in death benefits and for sickness and accidents the sum of $466,294.11. There were 22,984 members. $3,142,323.24 were expended in the construction of the Trenton Cut-off, referred to in the last annual report, and which it is expected will be completed during the present year.

The other important items of expenditure were: The work upon the New York Bay Railroad, a line which is intended to reach a rapidly improving portion of Newark, and at the same time furnish an alternate line for your freight trains through that city; the construction of additional branches to the Southwest Pennsylvania Railway and the Western Pennsylvania Railroad; and the construction of the McKeesport & Bessemer Railroad—a line intended to connect the Pittsburgh, Virginia & Charleston Railway with the manufacturing industries of McKeesport, and necessitating the building of a bridge over the Monongahela River at that point.

During the past year the principal lines forming the Southwestern system, to wit, the Pittsburgh, Cincinnati & St. Louis Railway, Cincinnati & Richmond Railroad, Jeffersonville, Madison & Indianapolis Railroad, and the Chicago, St. Louis & Pittsburgh Railroad, were merged into one company, under the name of the Cincinnati, Chicago & St. Louis Railway Company. It is believed that through such consolidation a stronger financial basis has been secured.

There were built at Altoona and the other shops east of Pittsburgh and Erie, for the main line and other roads in your interest, on capital and repair account, 132 locomotives, 110 passenger cars, 23 baggage, express and mail cars, 2,202 freight cars, 8 refrigerator cars, and 398 cabin and maintenance of way cars.

The gross earnings per mile received from the main line (358 miles) in 1890 were	$87,031.14
In 1889 were	81,713.65
Showing an increase of	$5,317.49

The per centage of operating expenses to earnings on all lines east of Pittsburgh and Erie was 67.94 for 1890 and 66.81 for 1889, showing an increase for the year 1890 of 1.13 per cent.

	Earnings per ton-mile. 1890.	Earnings per ton-mile. 1889.	Cost per ton-mile. 1890.	Cost per ton-mile. 1889.
	Cents.	Cents.	Cents.	Cents.
Pennsylvania Railroad Div.	0.601	0.626	0.401	0.401
United Railroads of N. J. Div.	1.157	1.178	0.987	1.023
Philadelphia & Erie R. R. Div.	0.516	0.556	0.346	0.352
All lines e. of Pittsburgh & Erie	0.655	0 686	0.463	0.473

	Earnings per passenger-mile. 1890.	Earnings per passenger-mile. 1889.	Cost per passenger-mile. 1890.	Cost per passenger-mile. 1889.
	Cents.	Cents.	Cents.	Cents.
Pennsylvania Railroad Div.	2.197	2.210	1.598	1.650
United Railroads of N. J. Div.	1.919	1.920	1.372	1.372
Phila. & Erie Railroad Div.	2.405	2.438	1.830	1.876
All lines east of Pitts. and Erie	2.077	2.082	1.504	1.527

LINES WEST OF PITTSBURGH, 1890.

The total earnings of the Pennsylvania Co. on lines operated directly by it were	$21,498,991	
Expenses	13,584,873	
Leaving net earnings	$7,914,118	
From this deduct: Rental, interest and liabilities of all kinds chargeable thereto	6,832,160	
Net profit on Pennsylvania Co.'s lines		$1,081,958
The total earnings of the Pittsburgh, Cincinnati, Chicago & St. Louis Railway Co. on lines operated directly by it were	$18,079,618	
Expenses	13,445,723	
Leaving net earnings	$4,633,894	
From this deduct: Rentals, interest, and liabilities of all kinds chargeable thereto	4,015,237	
Net profit on Pittsburgh, Cincinnati, Chicago & St. Louis Railway Co.'s lines		618,657
Net profit on lines west of Pittsburgh for 1890		$1,700,615
Net profit on lines west of Pittsburgh for 1889		1,234,684
Comparative increase on lines west of Pittsburgh for 1890		$465,931

The profit on the other lines west of Pittsburgh, on account of which the company has assumed direct obligations, or in which it is largely interested through ownership of securities, but which are operated through their own organizations, is $56,316, which, added to the profit shown in the above statement, $1,700,615, leaves a profit on all lines west of Pittsburgh for 1890 of $1,756,932. The profit on lines west of Pittsburgh for 1889 was $1,280,363, showing a comparative increase for 1890, compared with 1889, of $476,569